

An incremental cue-weighting approach to lexical tone learning

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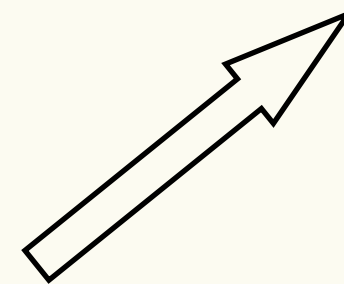


How do we know that it's a 'chair'?

↓
category

↓
countless dimensions

↓
selective attention

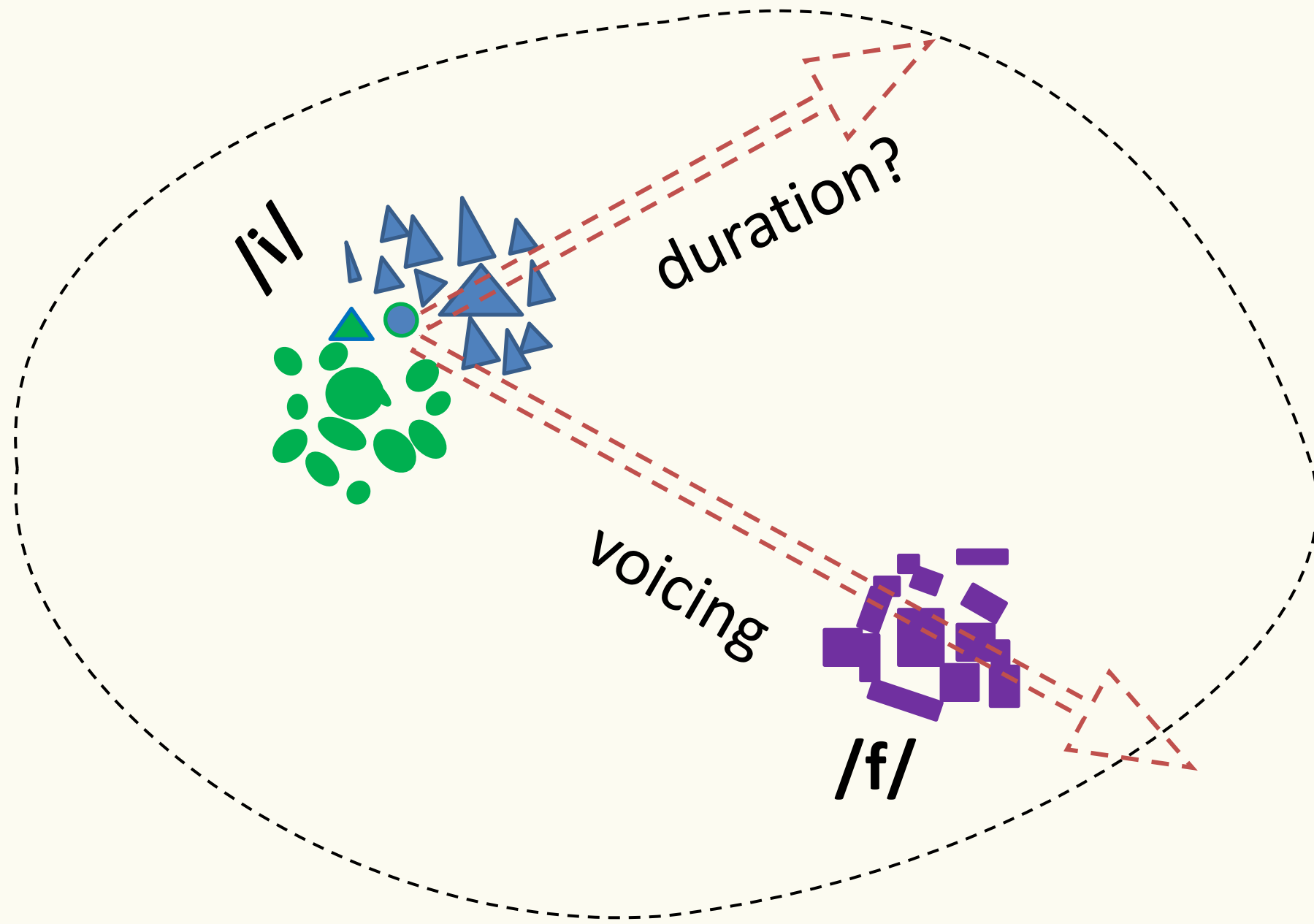


Speech sound contrasts: e.g., b?d
bid, bed, bad...

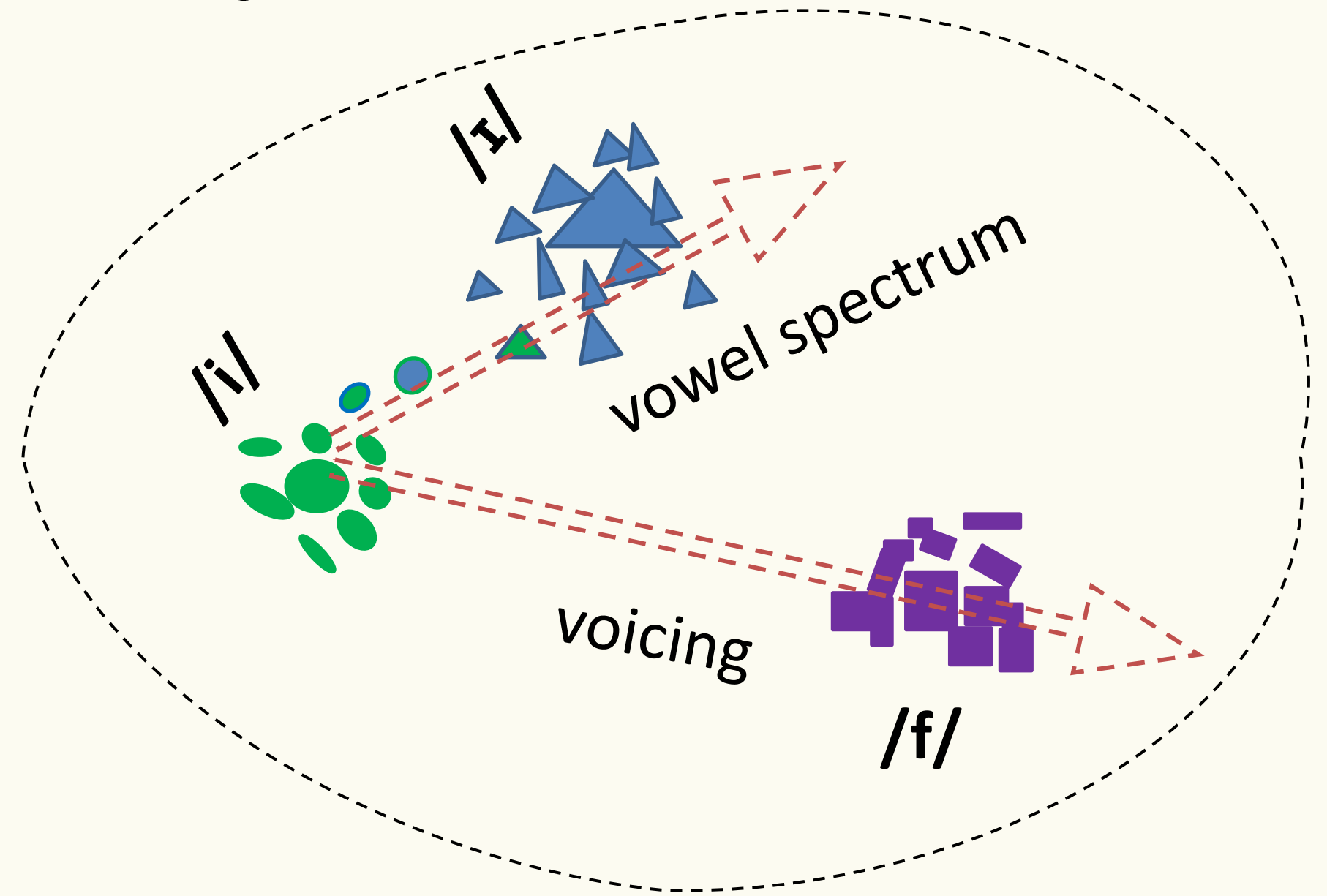
Selective attention and category perception

- Attention-to-dimension (A2D) models (Francis & Nusbaum, 2002)
 - Attentional weights are shaped through past experience.
- First language (L1) acoustic cue weighting affect L2 perception (Kuhl et al., 2008)
- L2 perceptual bias.

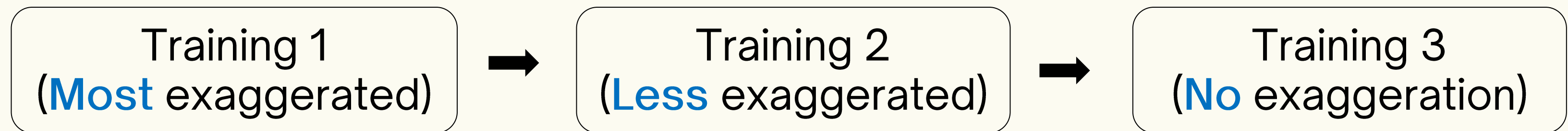
L1 Spanish



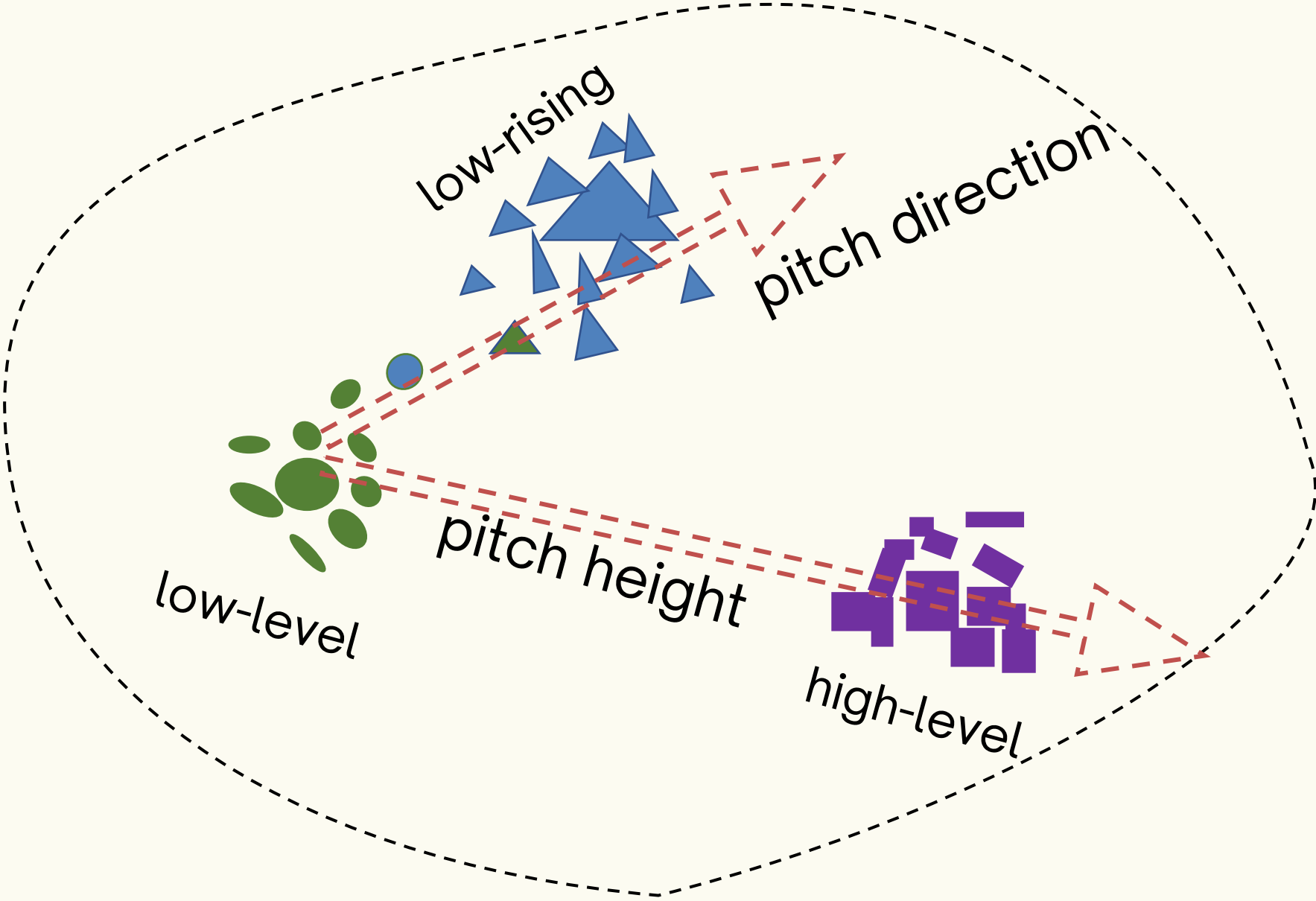
L1 English



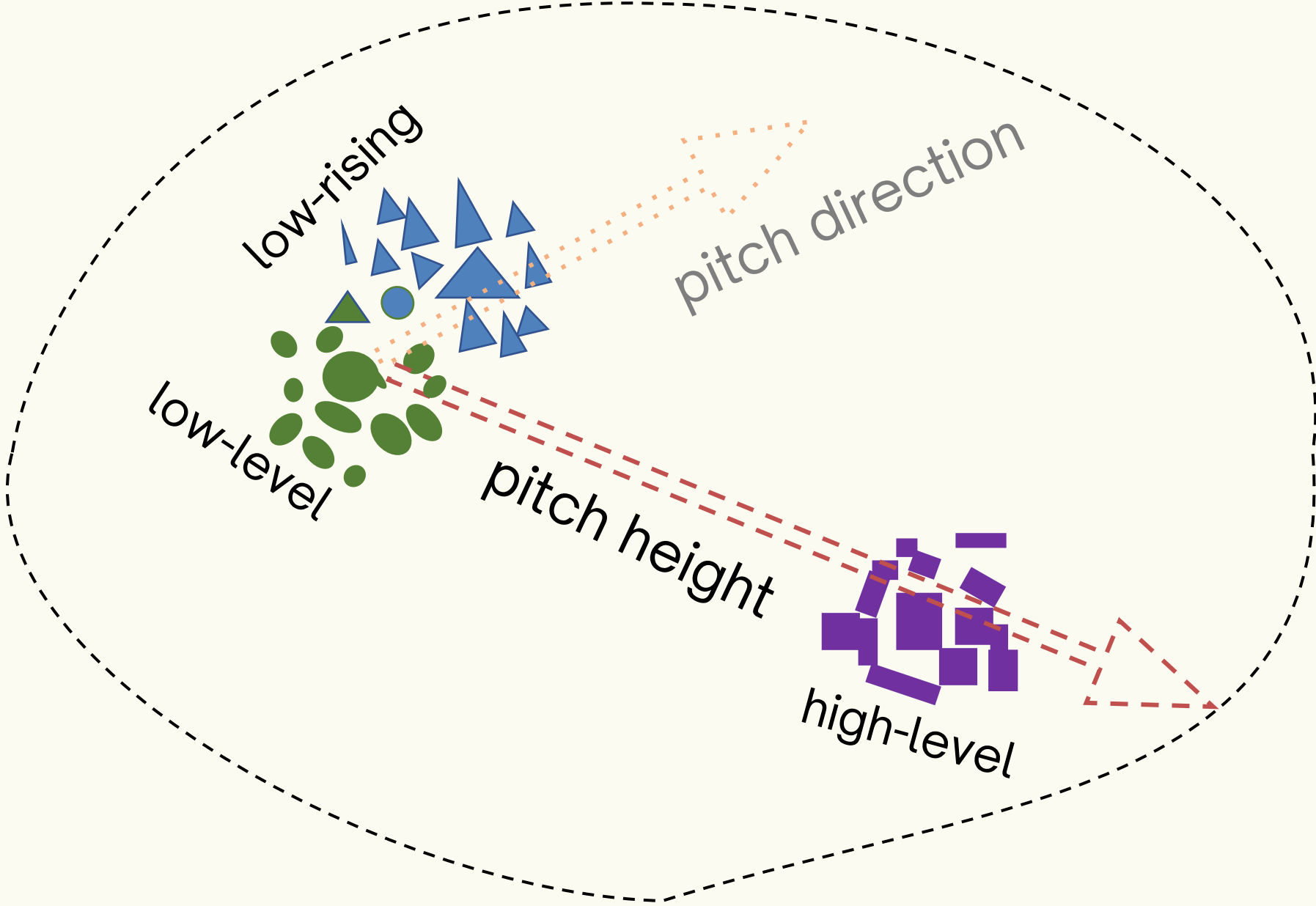
Cue exaggeration? – Incremental cue training



Lexical tone





Tonal listeners



Non-tonal listeners

Study 1: RQ

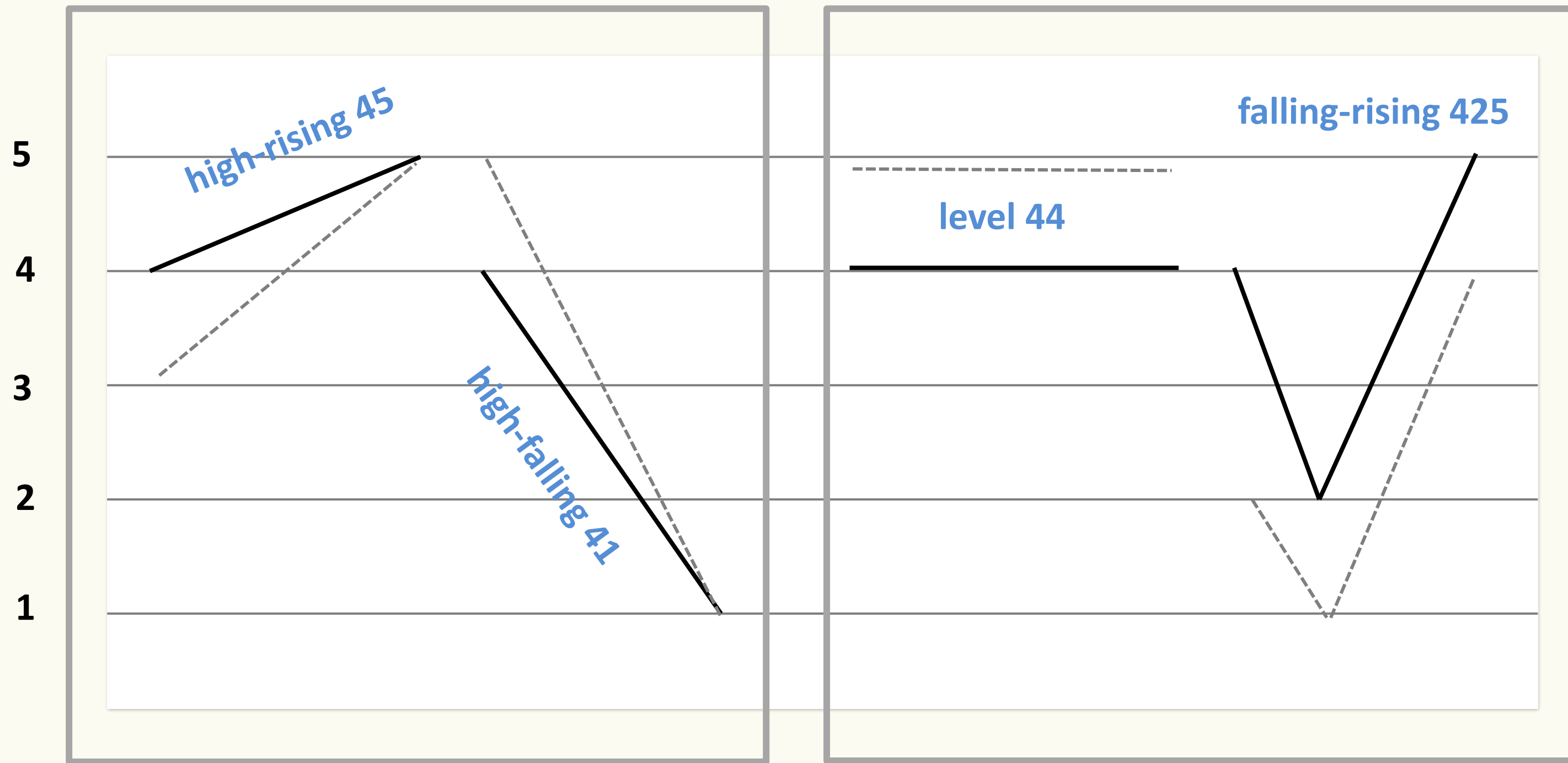
Pitch direction

Is **Incremental cue training**  more beneficial than **fixed unmanipulated stimuli exposure**  in lexical tone perceptual learning?

Participants: English listeners with no tonal language experience

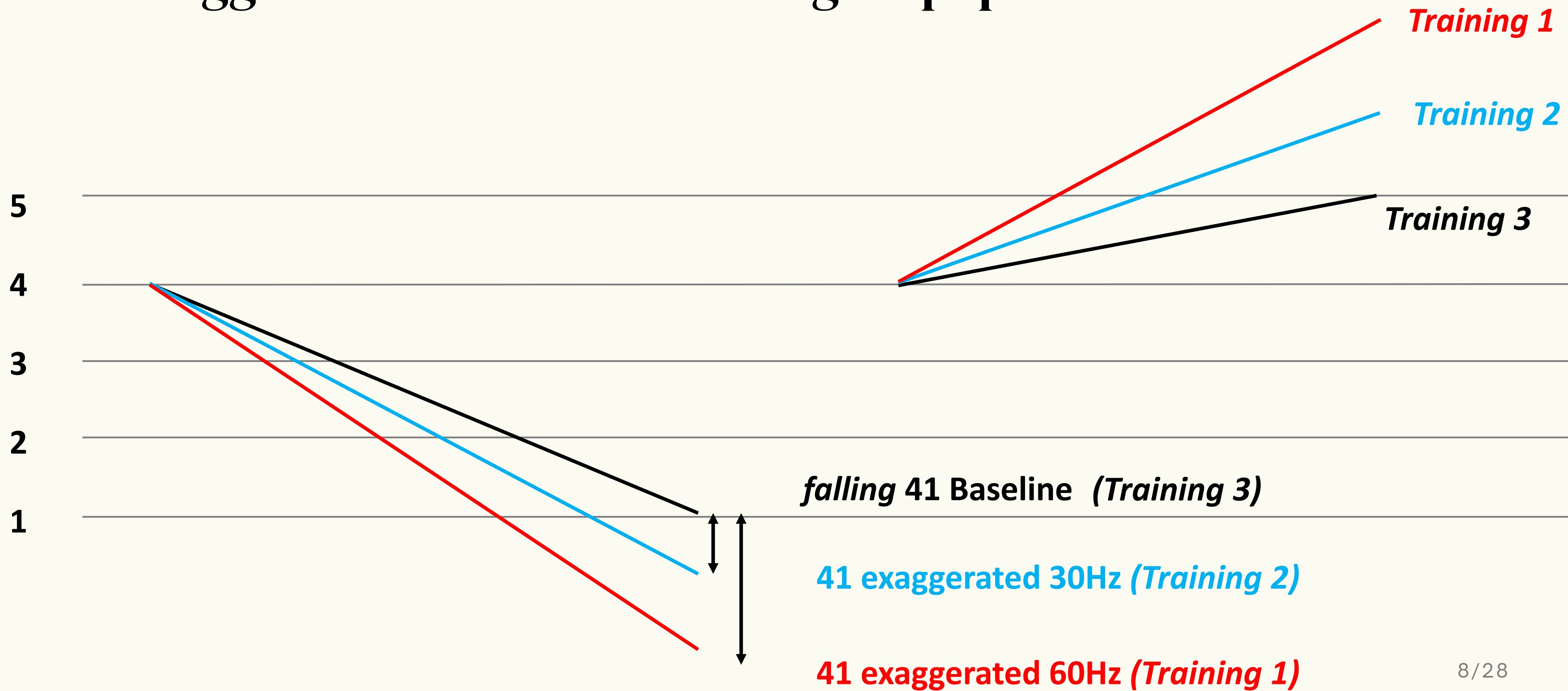
Training

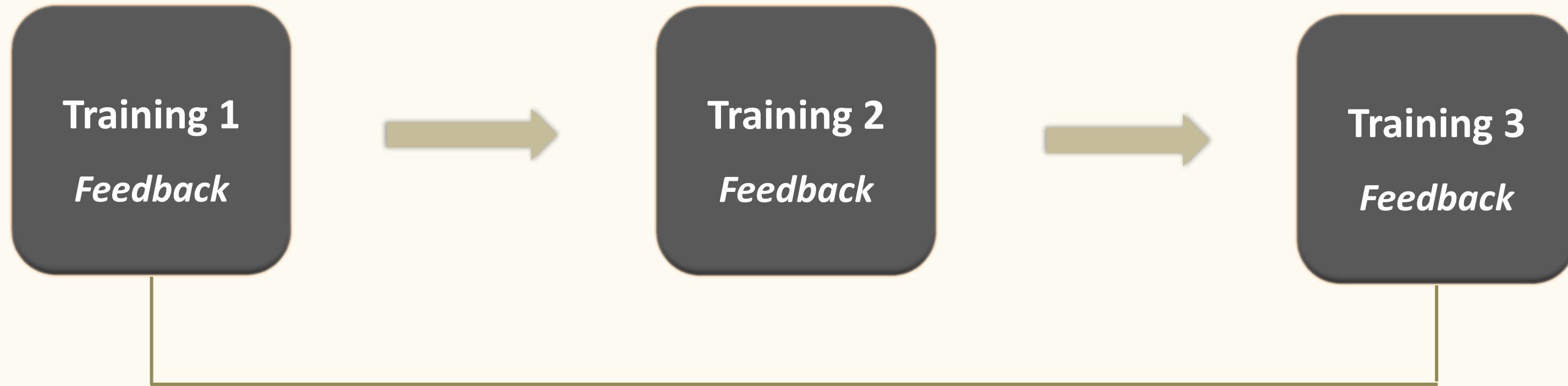
Tests



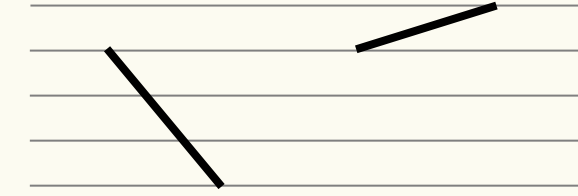
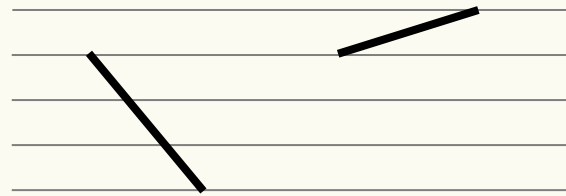
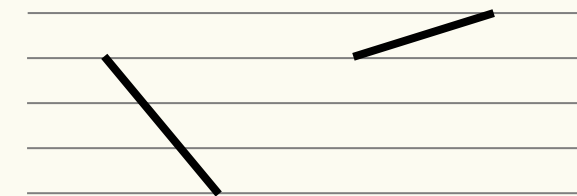
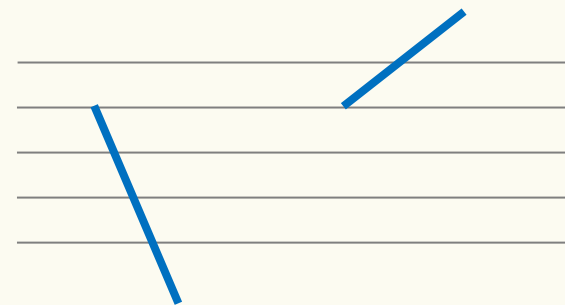
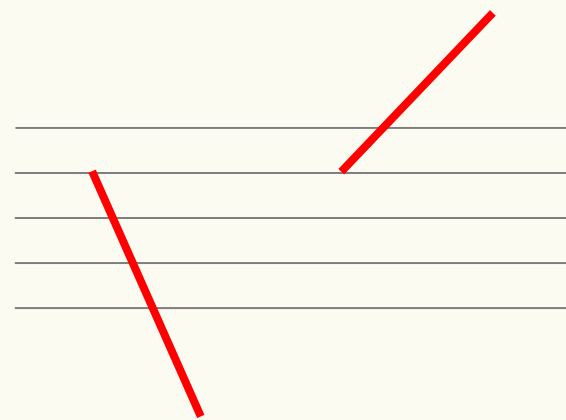
9 Syllables: /pa:/, /ta:/, /ka:/, /pi:/, /ti:/, /ki:/, /pu:/, /tu:/, and /ku:/

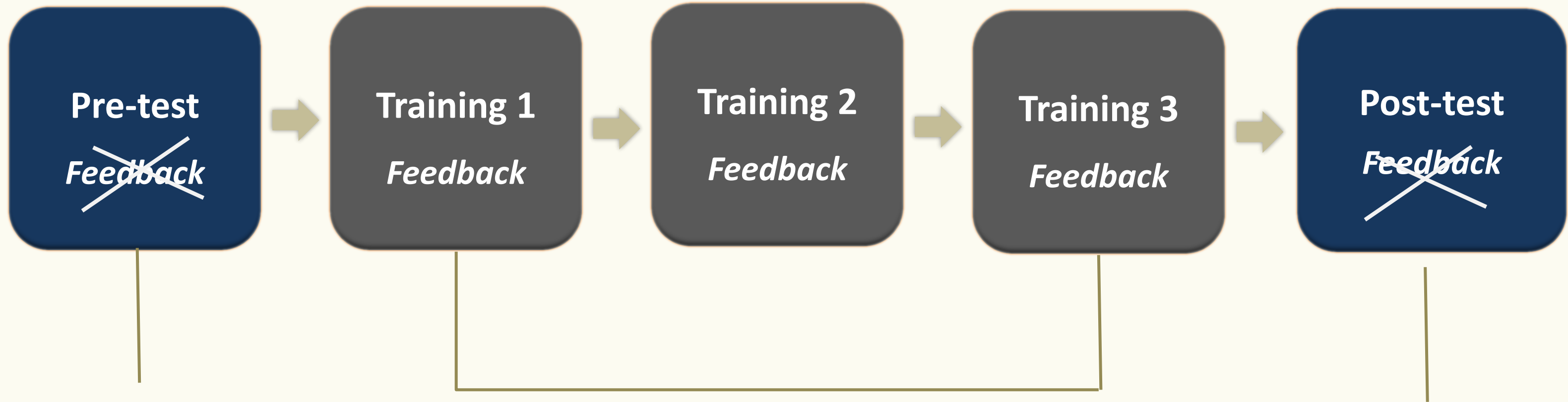
Cue exaggeration for incremental group: pitch direction



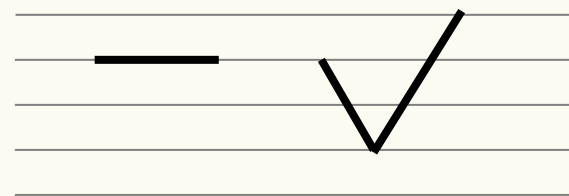


ABX tasks

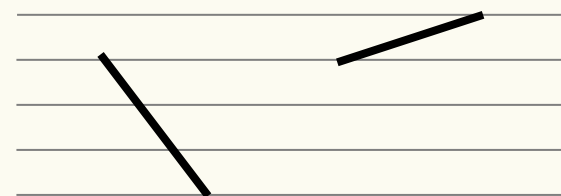




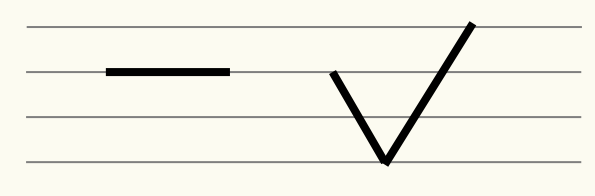
*44 vs 425
level vs. falling-rising*



*41 vs 45
high-falling vs high-rising*



Same as pre-test



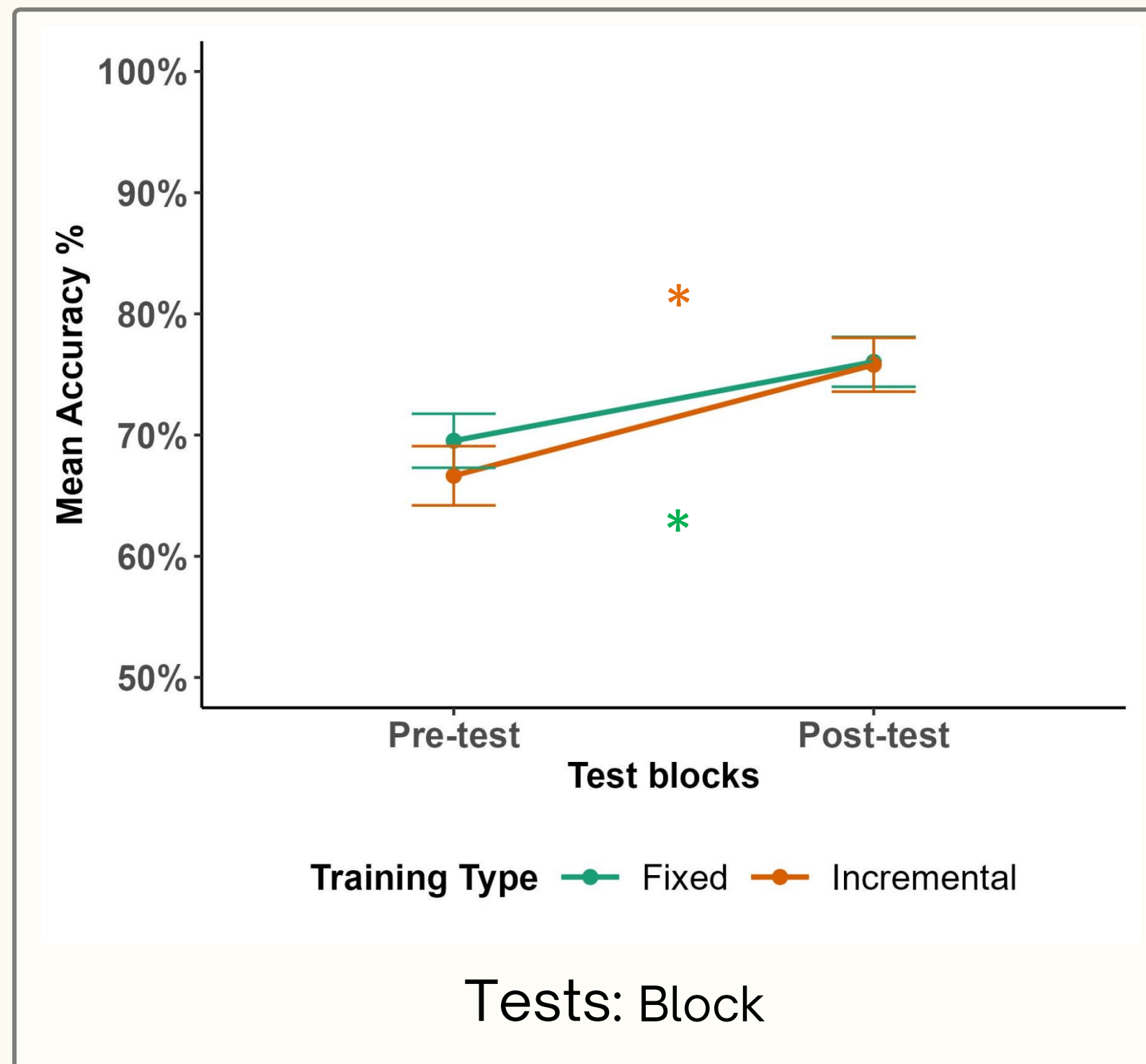
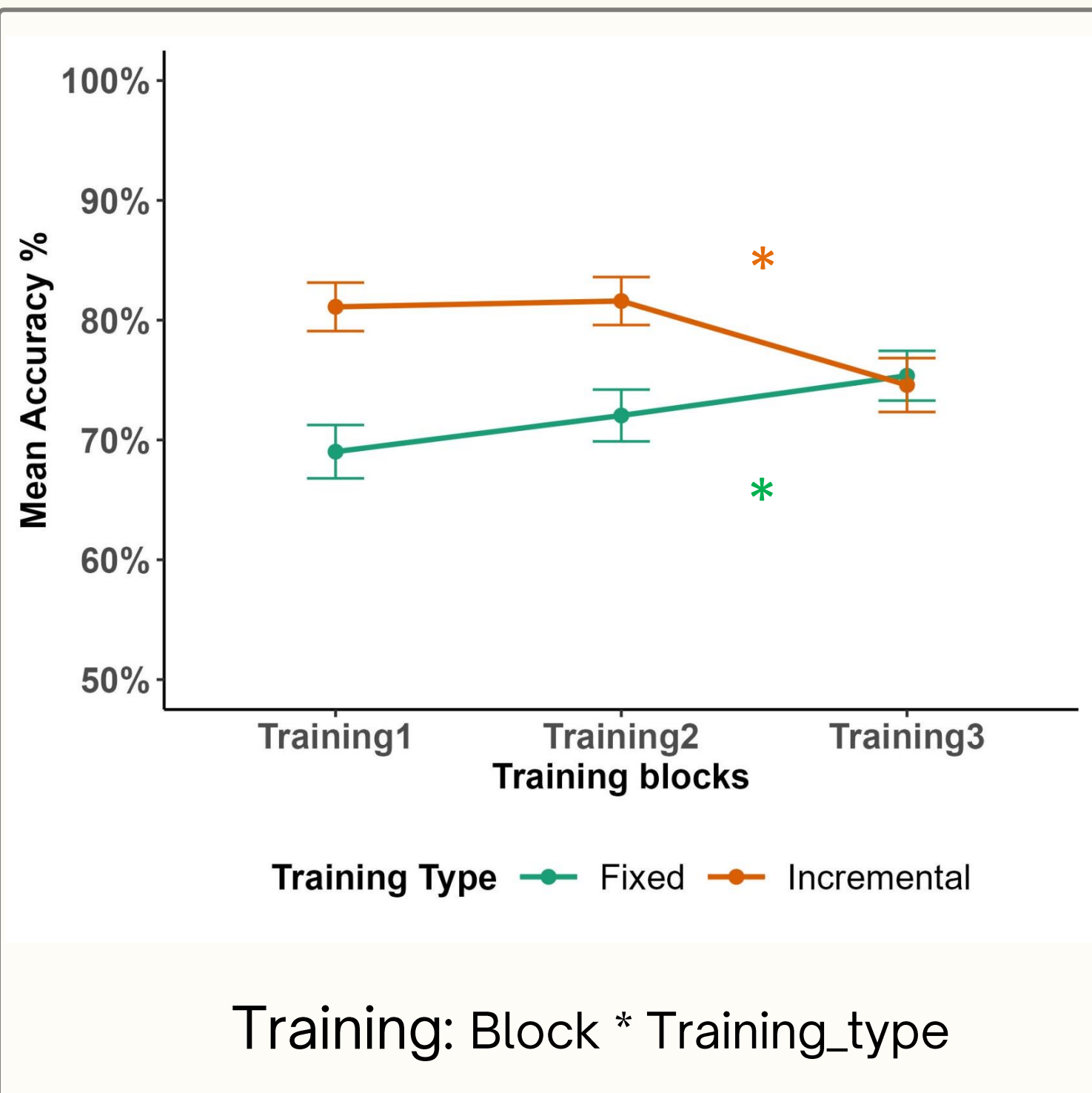
Data analysis

- Mixed-effect logistic/linear regression models.
- Backward model comparison through likelihood ratio tests.
- Training or tests data are analysed separately.

- Model structure:

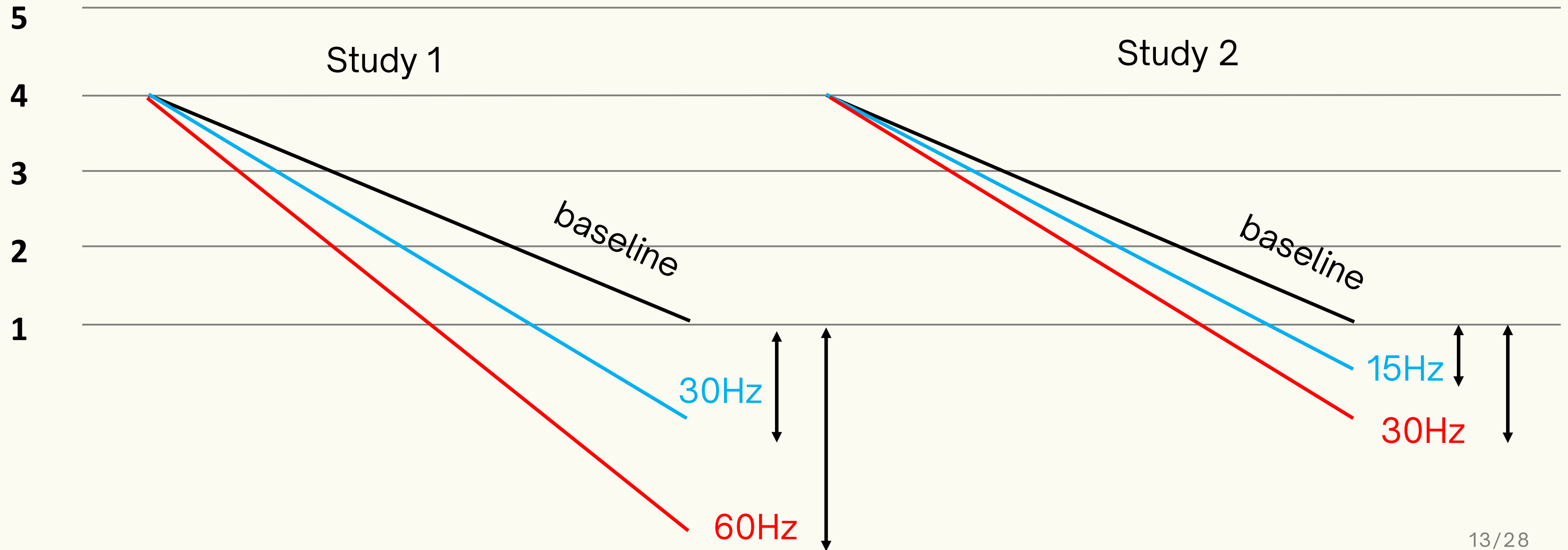
accuracy ~ block + training_type + block:training_type + (1+block|participant) + (1|syllable)

Study 1 Results: Accuracy

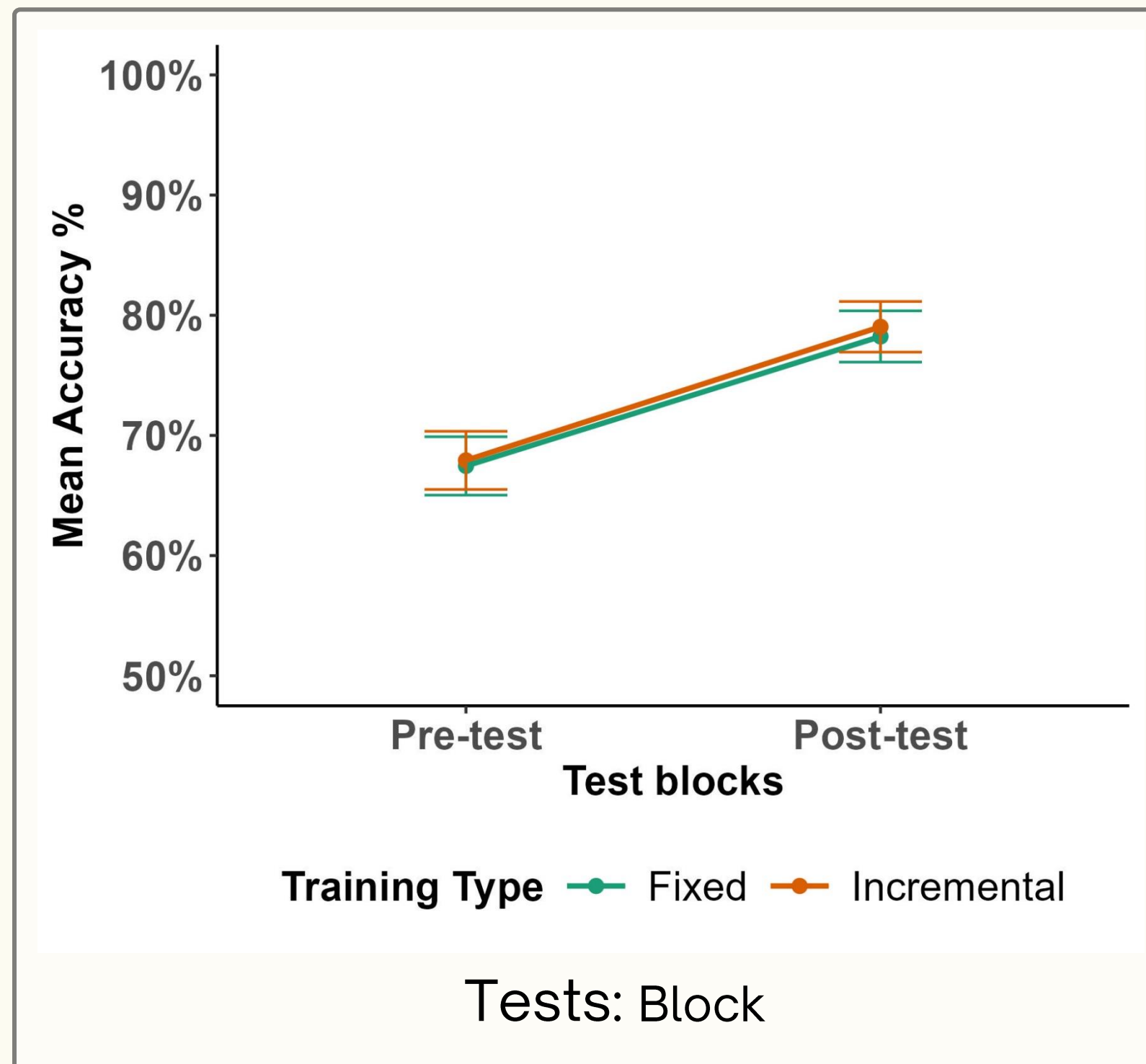
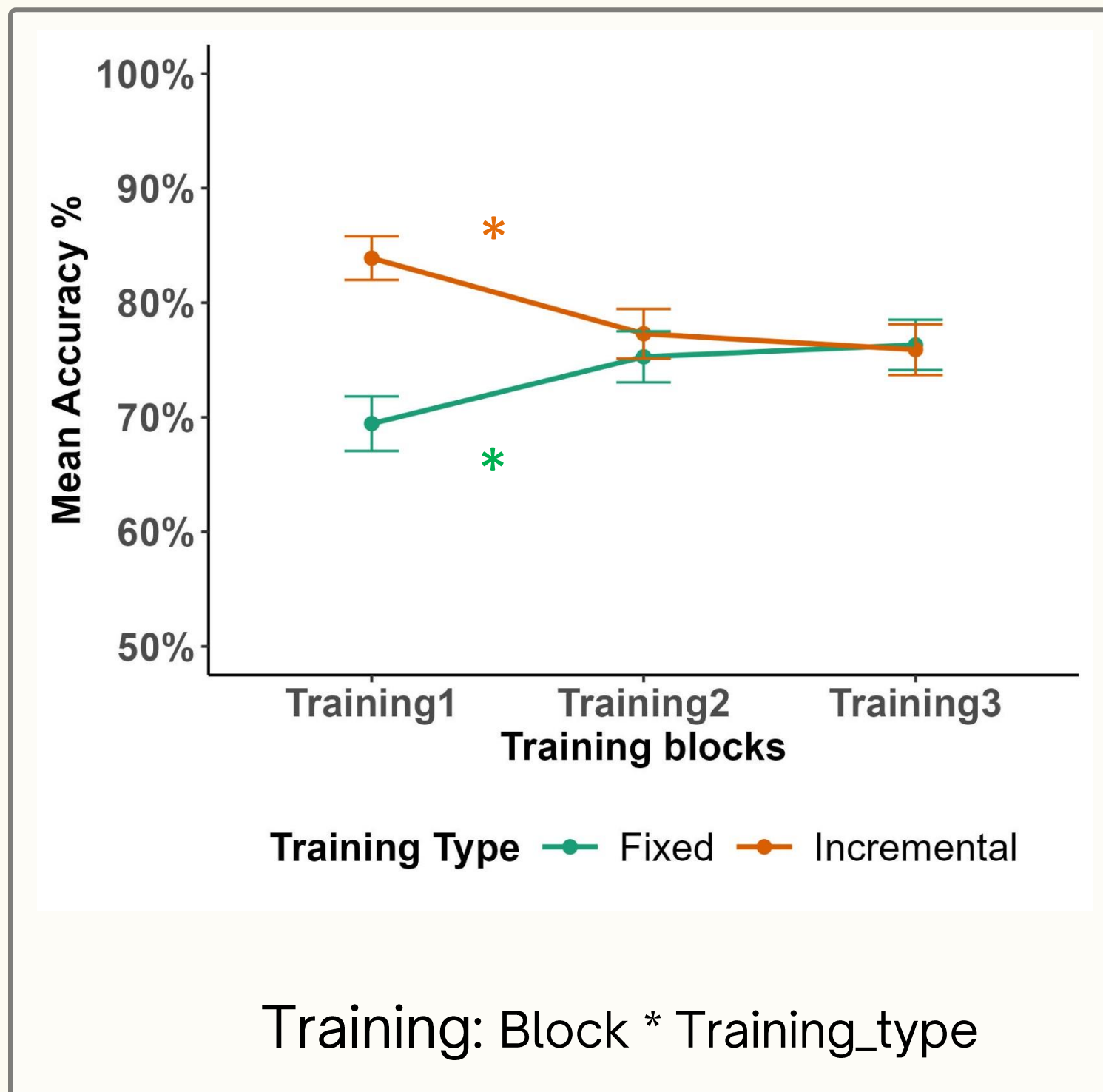


Study 2

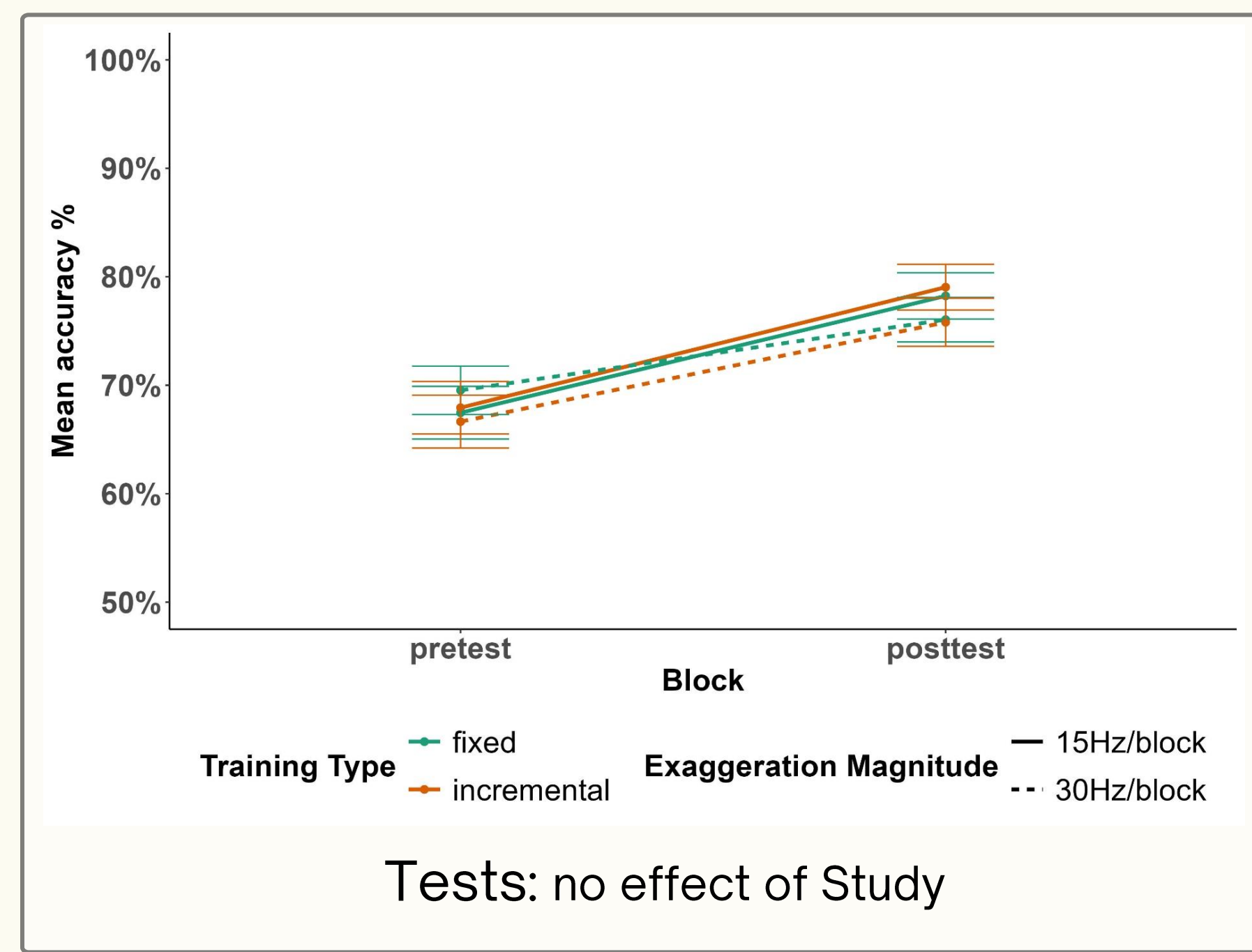
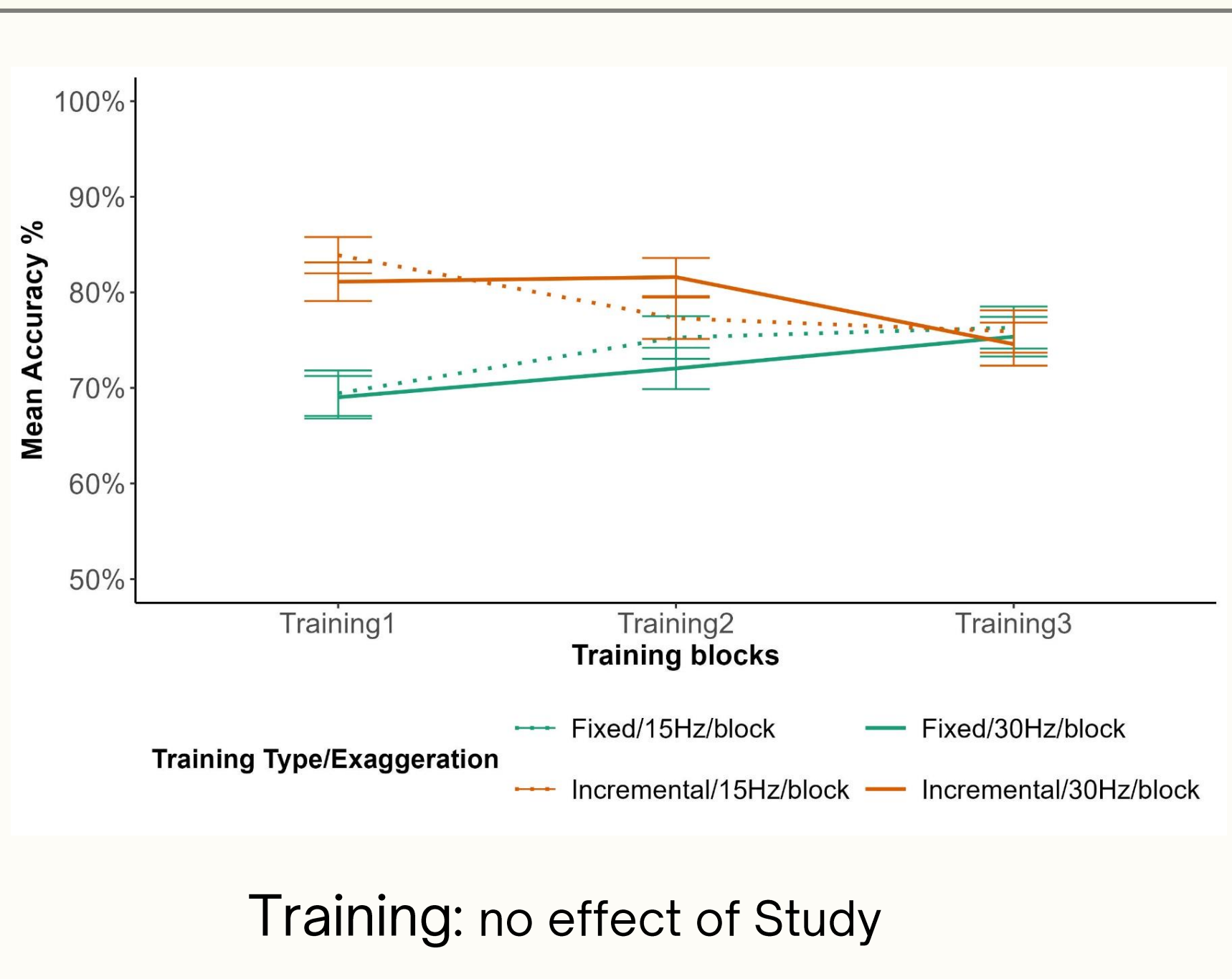
RQ: What would happen if we reduce exaggeration steps?



Study 2 Results: Accuracy



Study 1 & 2 Results: Accuracy



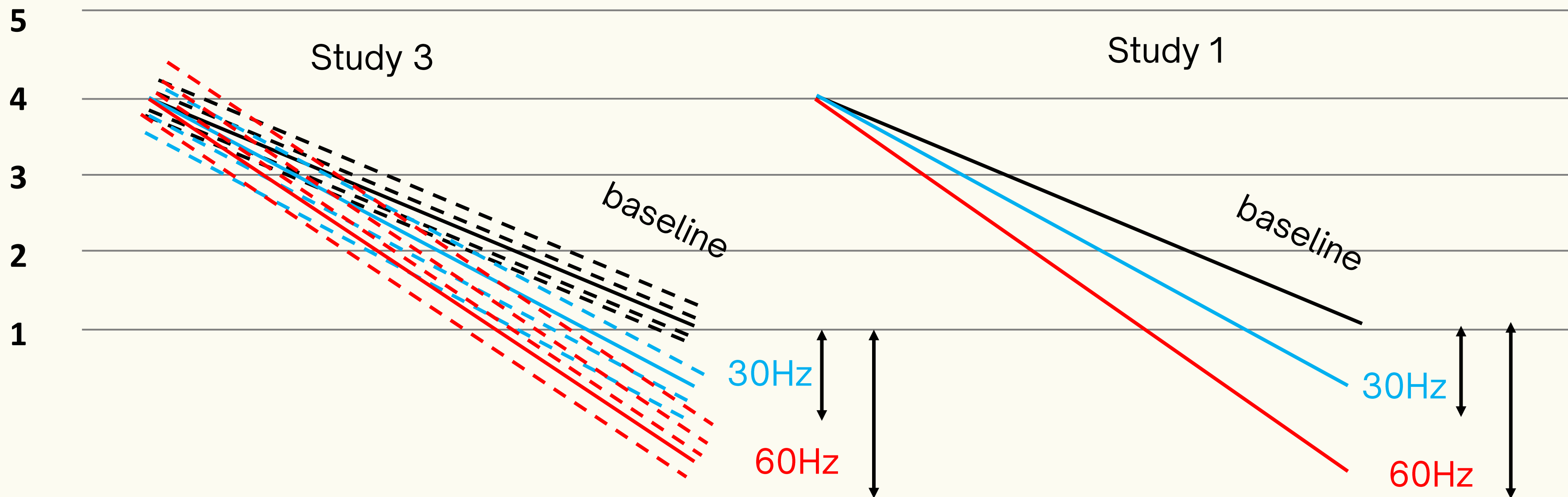
Study 3

Can we elicit incremental benefits with increased task difficulty?

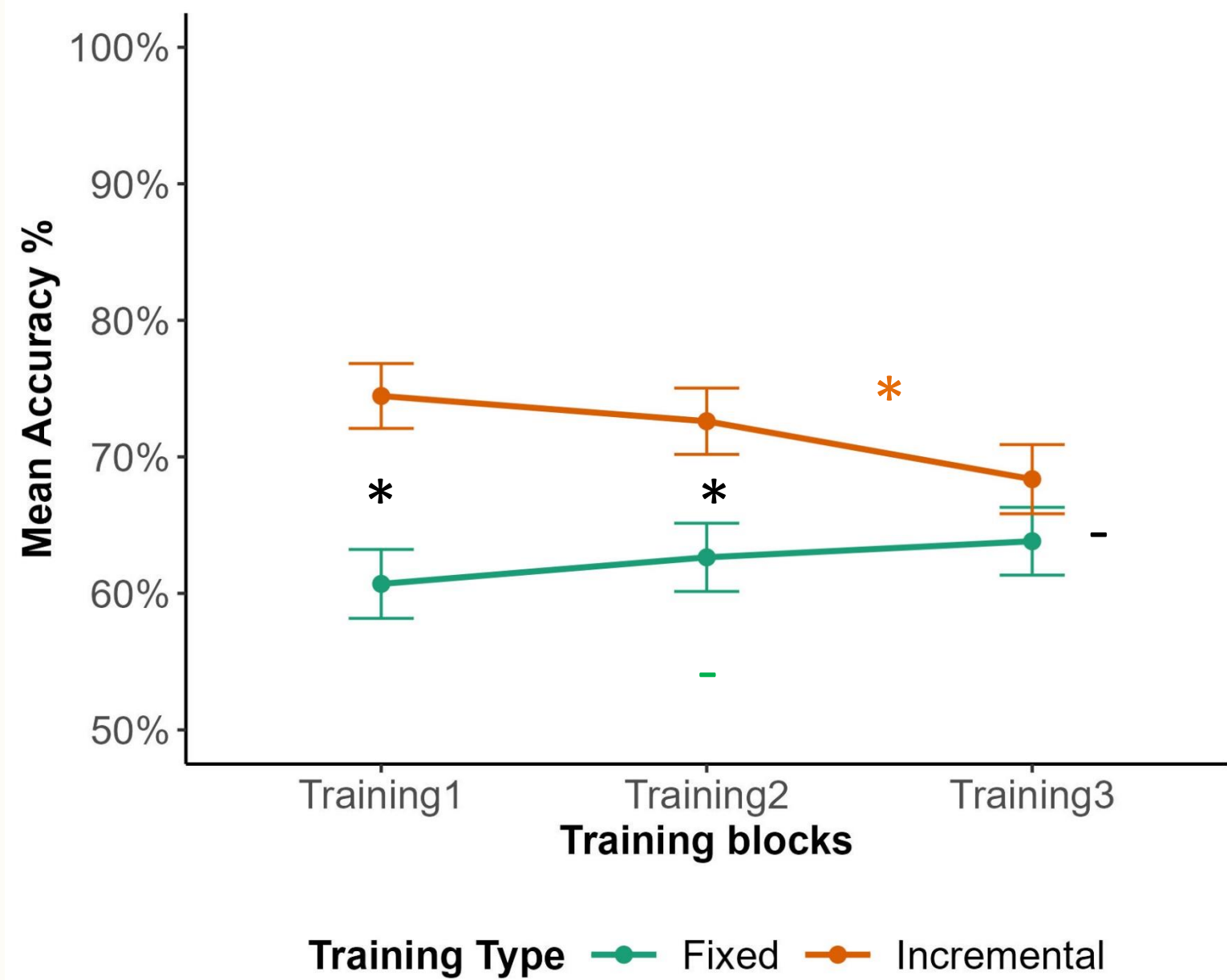
- Multi-dimensional learning (Kondaurova & Francis, 2010, Pashler & Mozer, 2013)
- With and without feedback (McCandliss et al., 2002)
- Speech impairment (Merzenich et al. 1996, Rvachew and Jamieson, 1989)
- Animal learning speech sounds...

Study 3 design

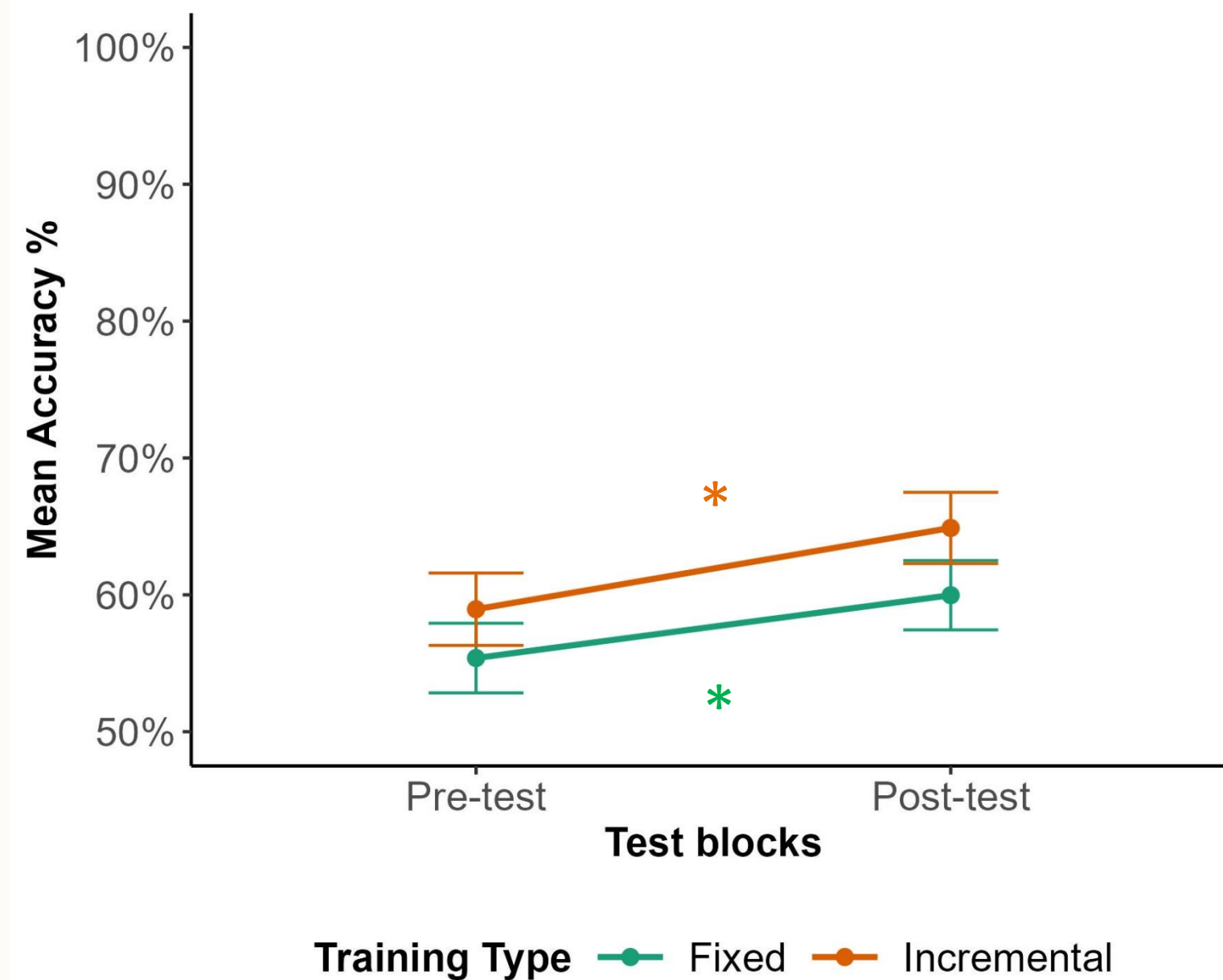
Adding F0 height variability, replicating Study 1 exaggeration and procedure



Study 3 Results: Accuracy

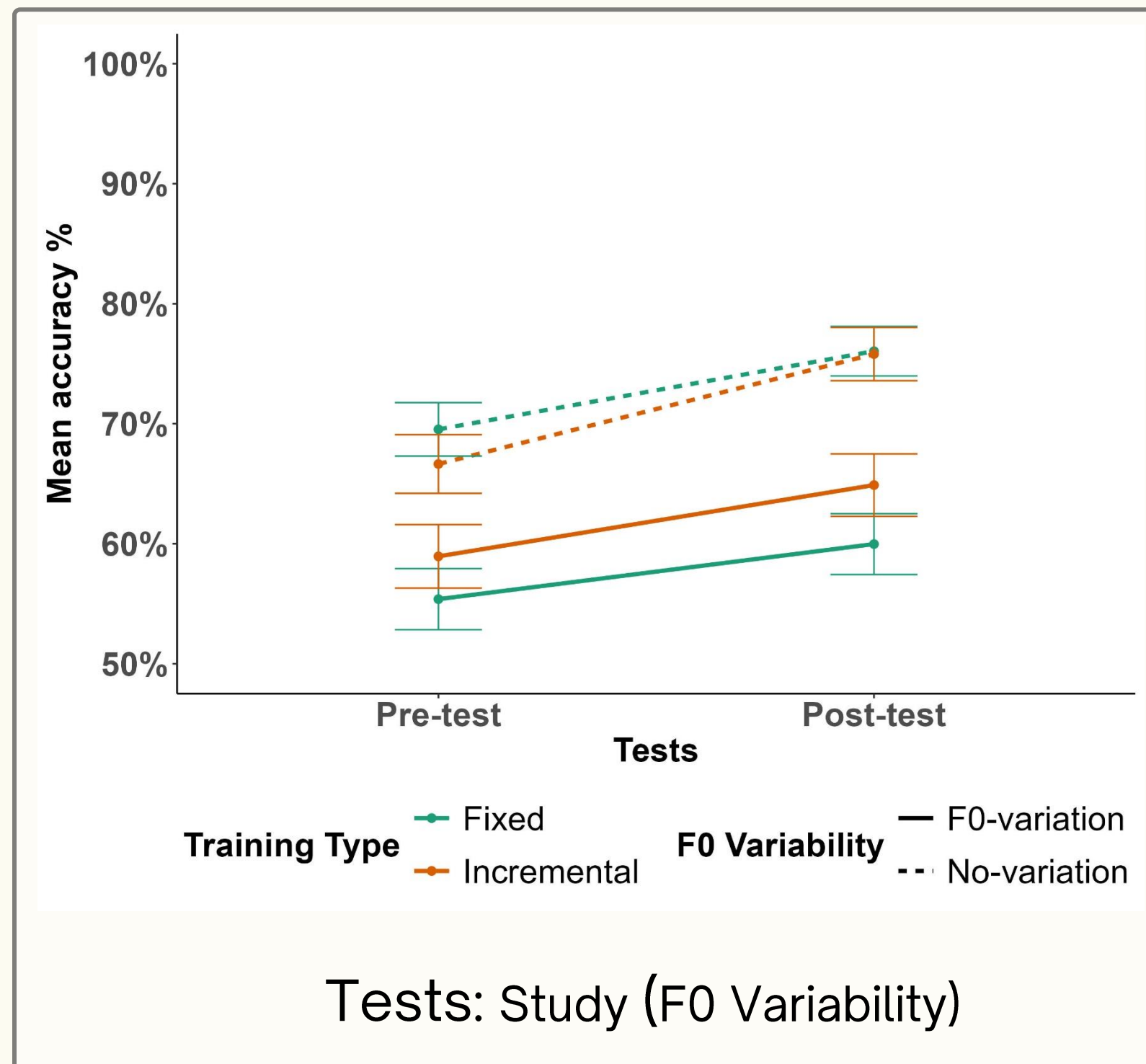
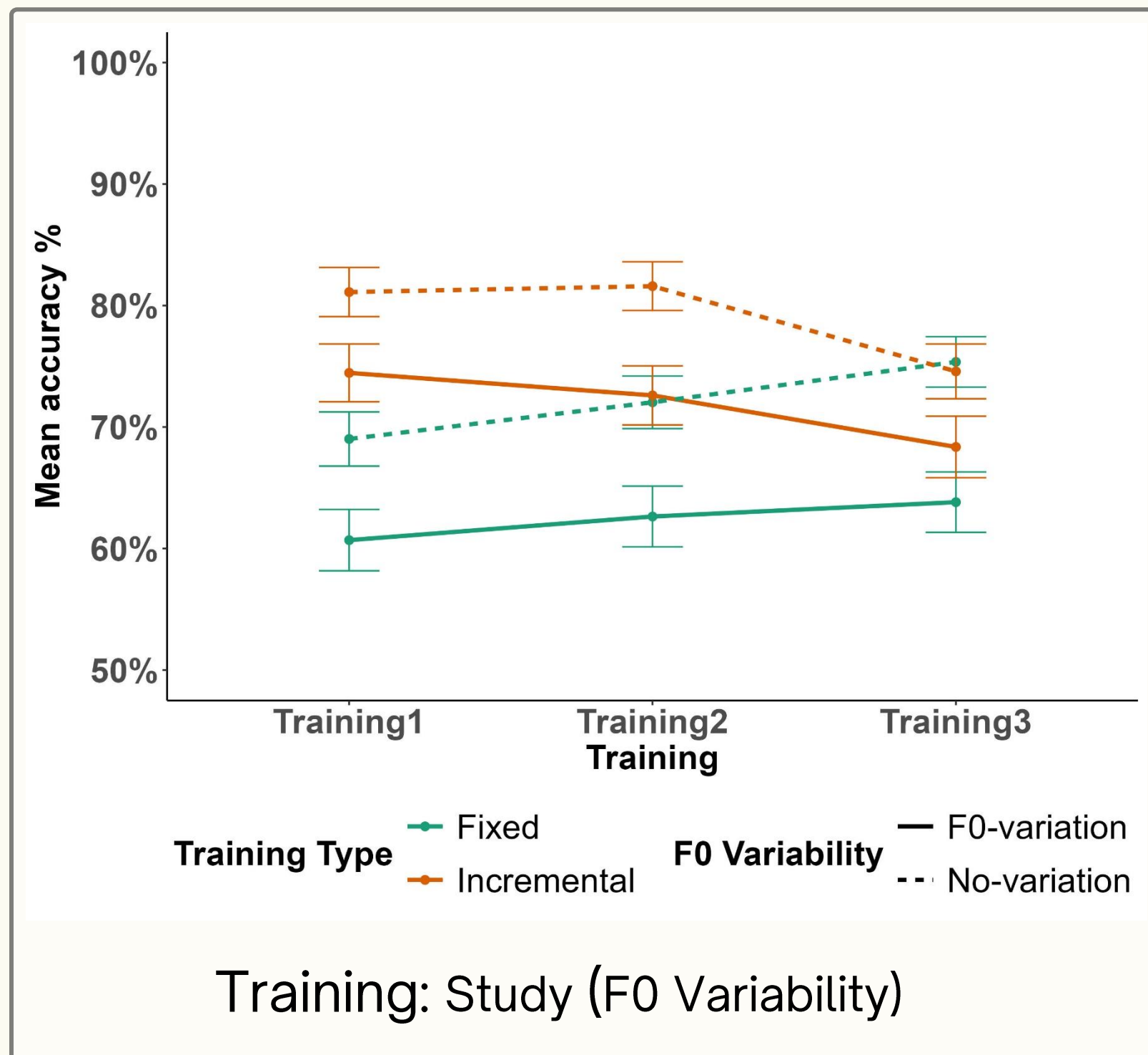


Training: Training_type, Block x Training_type



Tests: Block

Study 1 & 3 Results: Accuracy



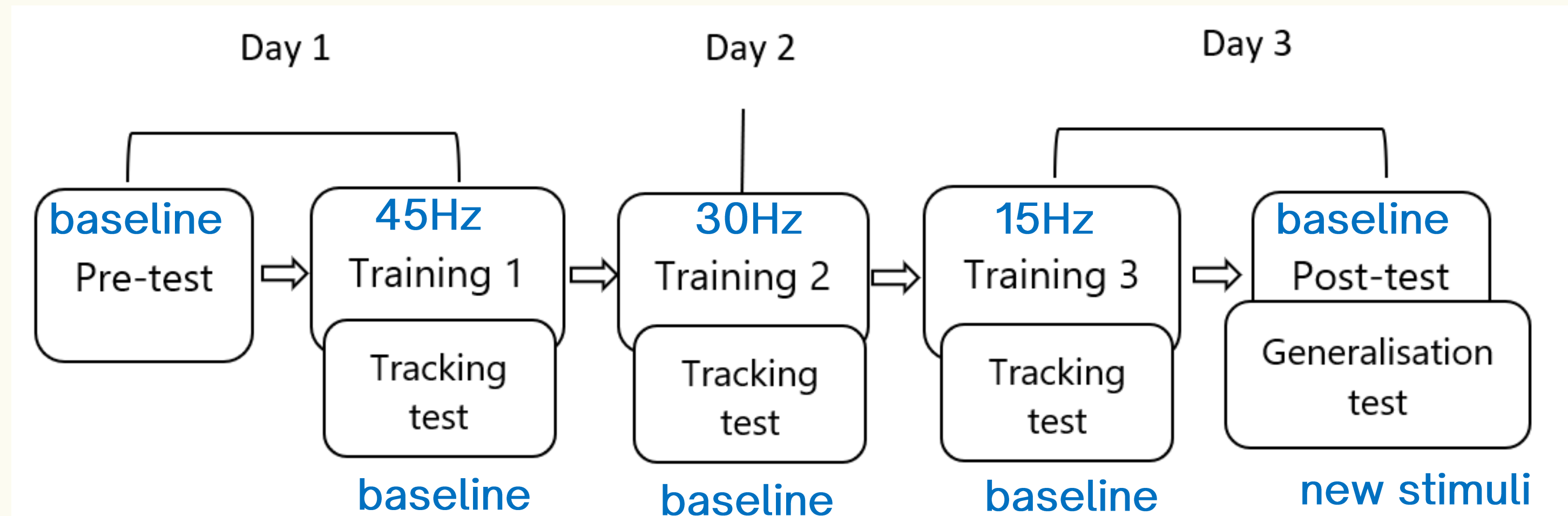
Study 4: RQ

Would extended training have an effect?

Extending training length into multiple days.

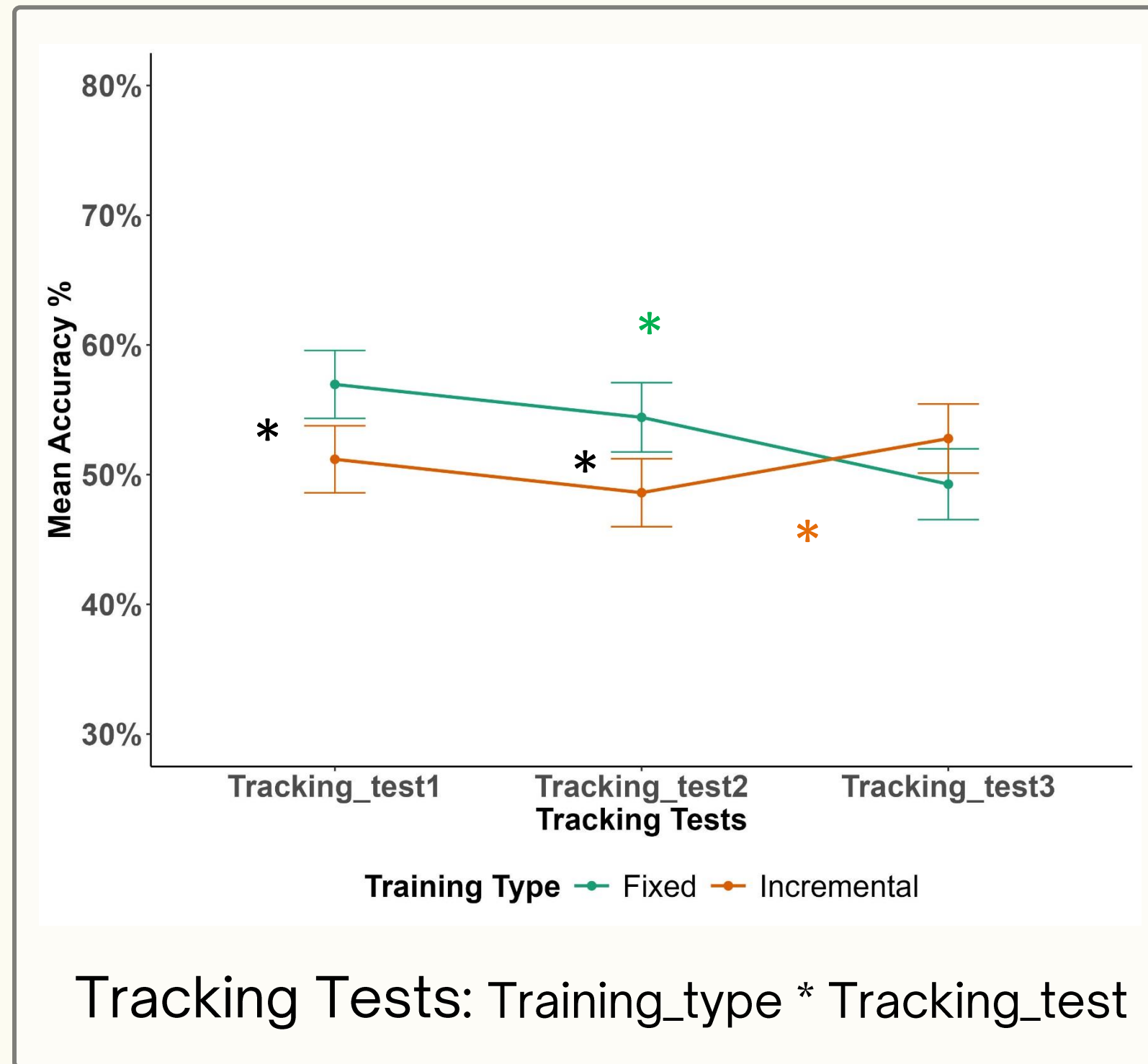
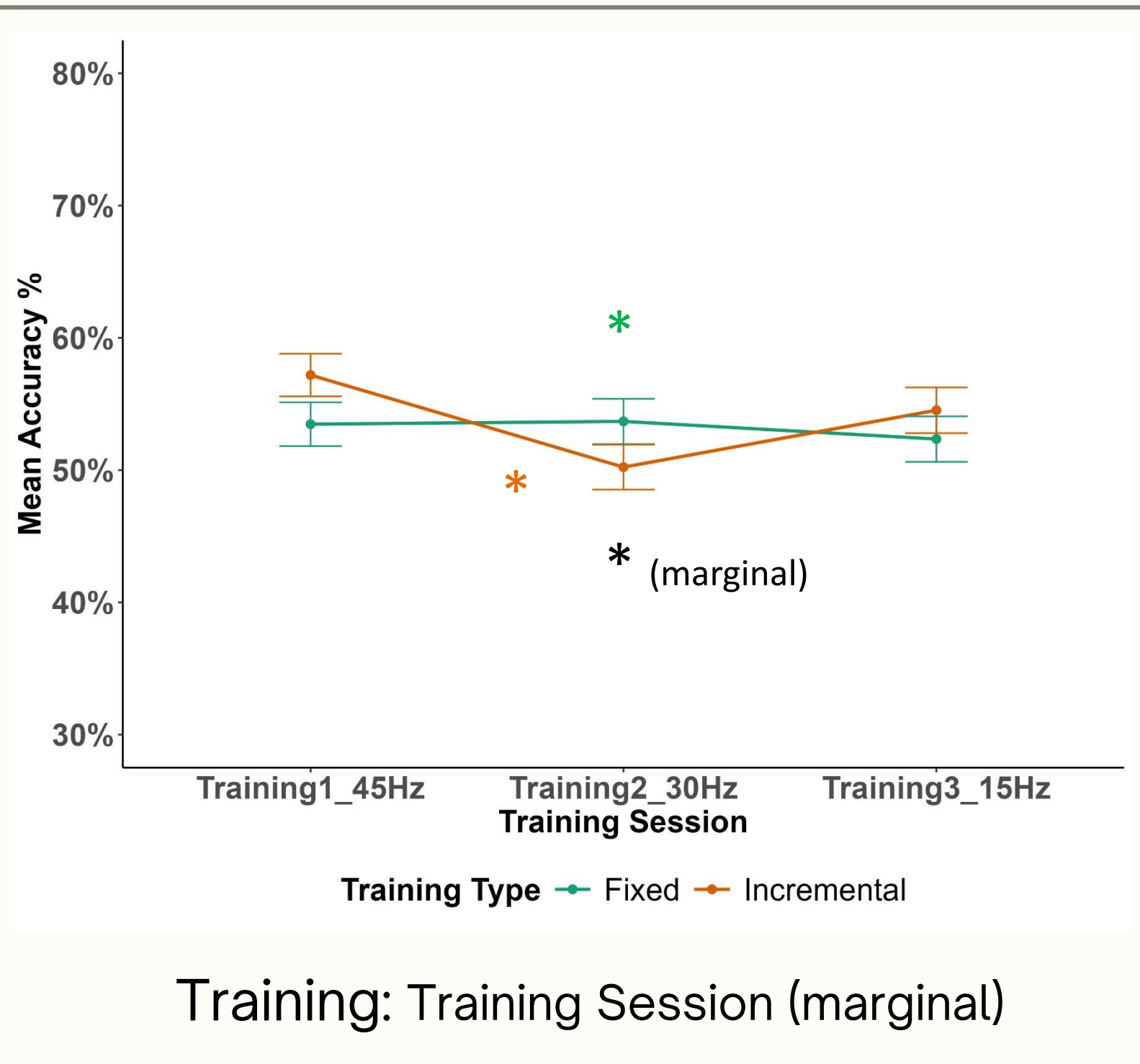
Increasing stimuli complexity and variability.

Study 4 design

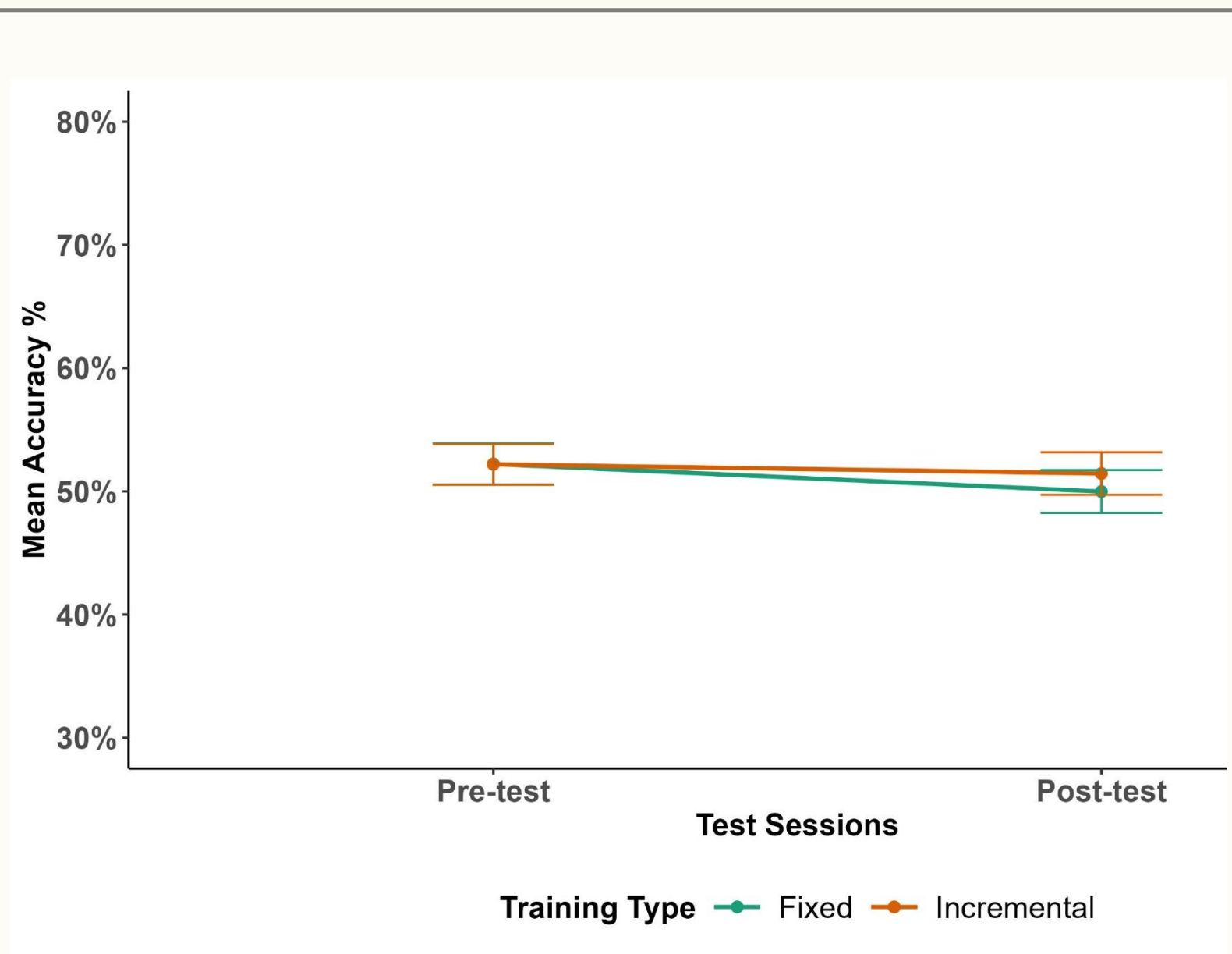


- All six tone pairs, plus F0 Variability.
- Feedback only in Training 1, 2, & 3

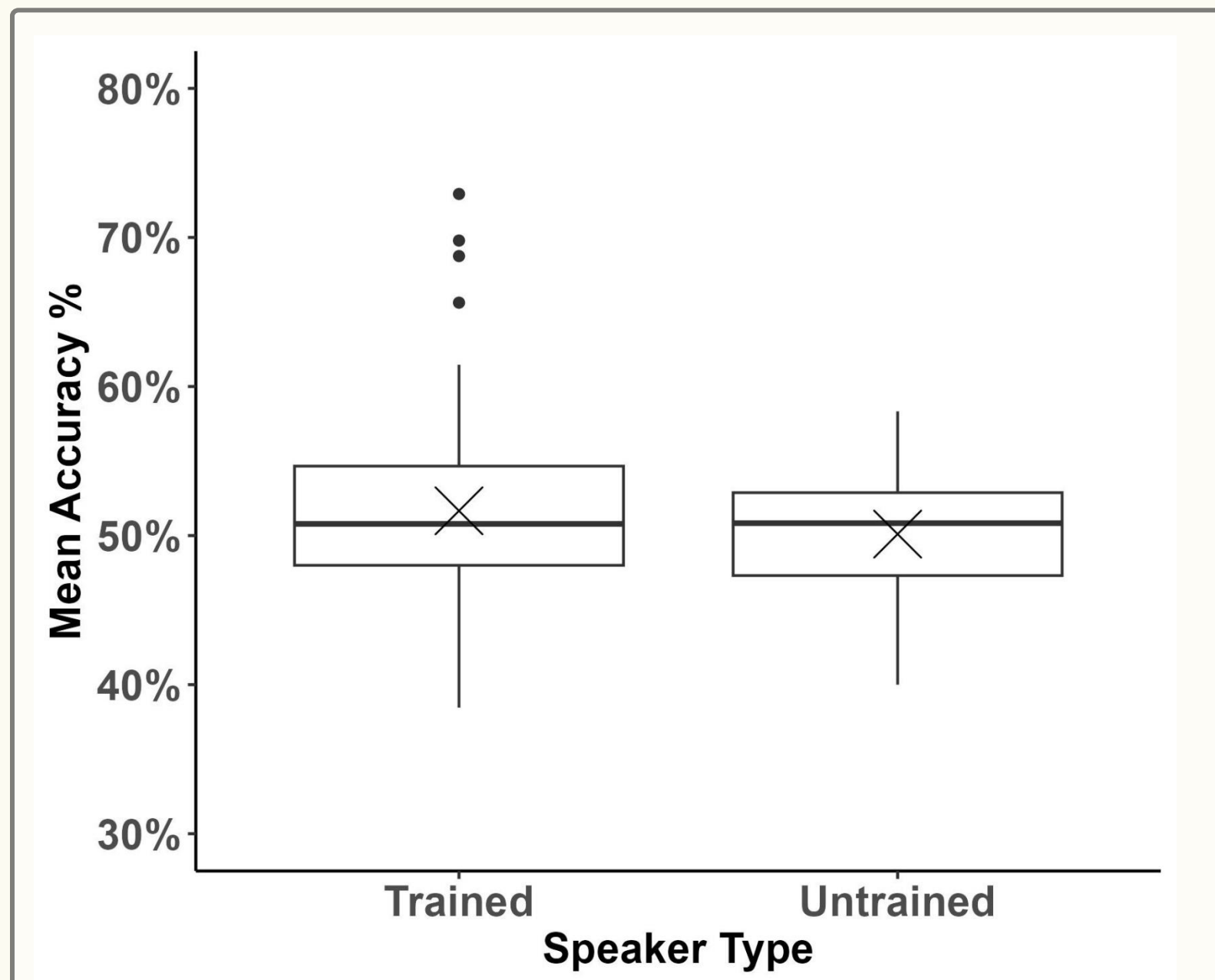
Study 4 Results: Accuracy



Study 4 Results: Accuracy



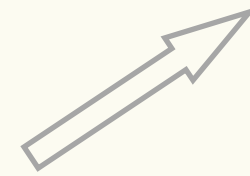
Pre-/Post-tests: non-significant



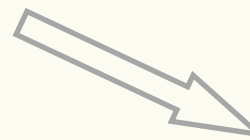
Generalisation-test: Speaker Type

Key findings

- Robust temporary boost
- No sustainable benefits
- Comparable training outcome



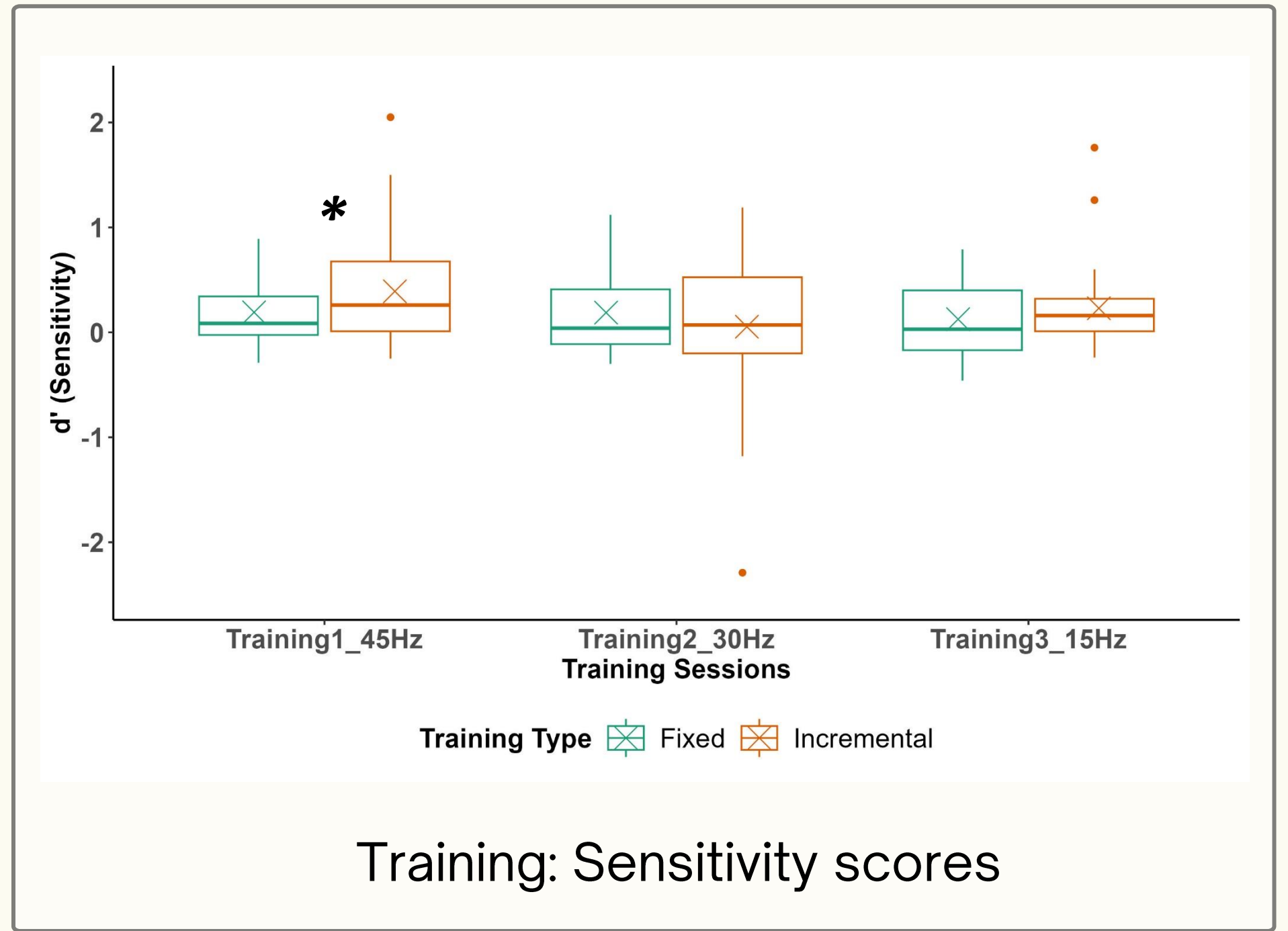
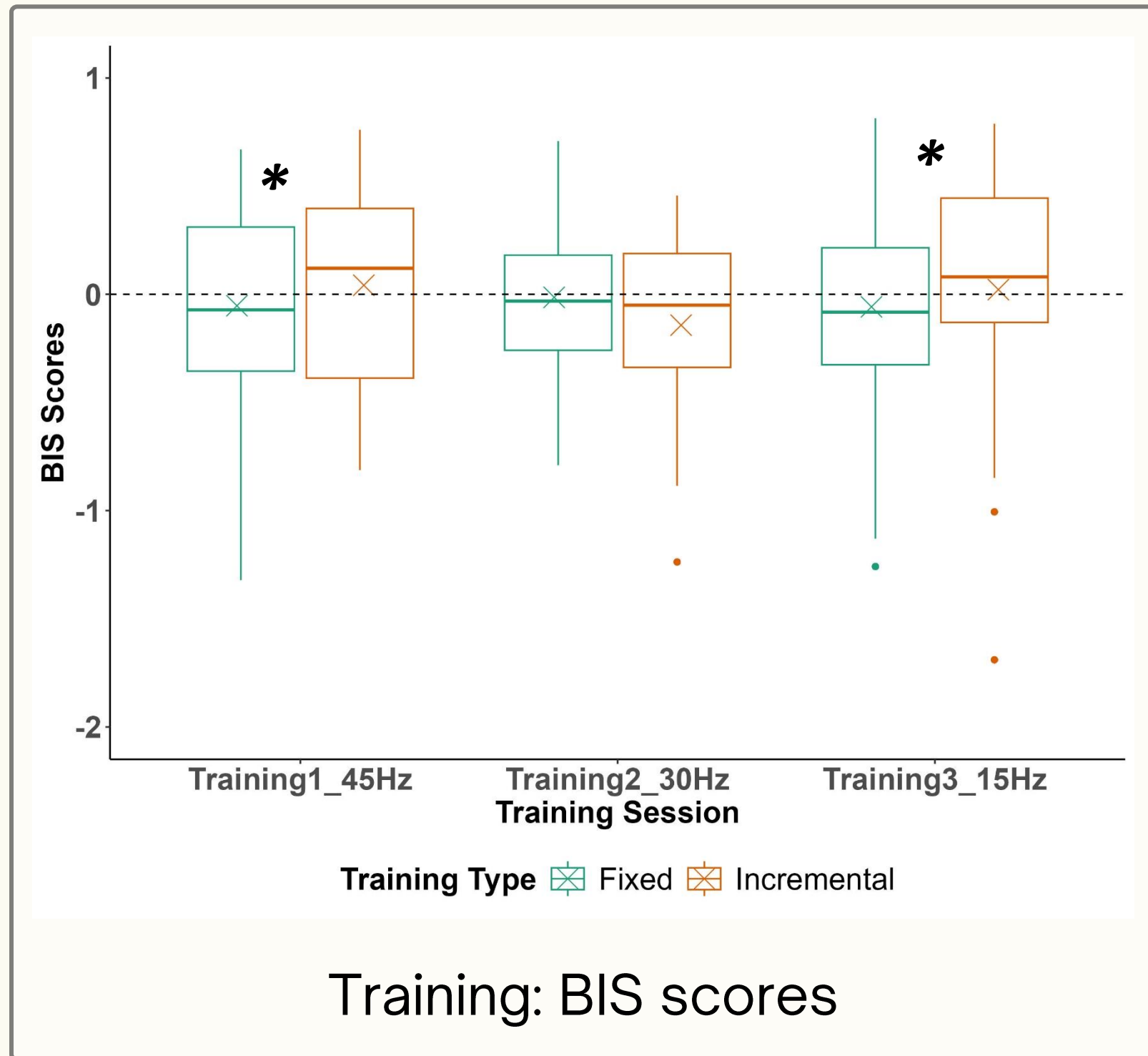
Auditory vs perceptual salience



Acoustic-phonetic link

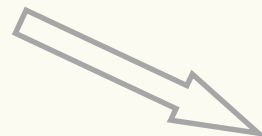
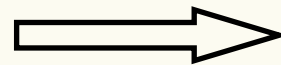
Statistical learning

Study 5 BIS & Sensitivity scores



Key findings

- Robust temporary boost
- No sustainable benefits
- Comparable training outcome



Auditory vs perceptual salience

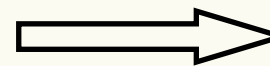
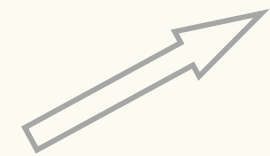
- Auditory: independent of L1
 - Evidence: the boost
- Perceptual: dependent of L1
 - Evidence: 1) similar boosting effect in Study 3 compared to Study 1. 2) BIS & Sensitivity scores.

Acoustic-phonetic link

Statistical learning

Key findings

- Robust temporary boost
- No sustainable benefits
- Comparable training outcome



Auditory vs perceptual salience

Acoustic-phonetic link

- Non-linear but transformative relationship



Statistical learning

- Categorisation
- Informativeness

Take away...

- Robust temporary boost
- No sustainable benefits
- Comparable training outcome



Auditory vs perceptual salience



Acoustic-phonetic link



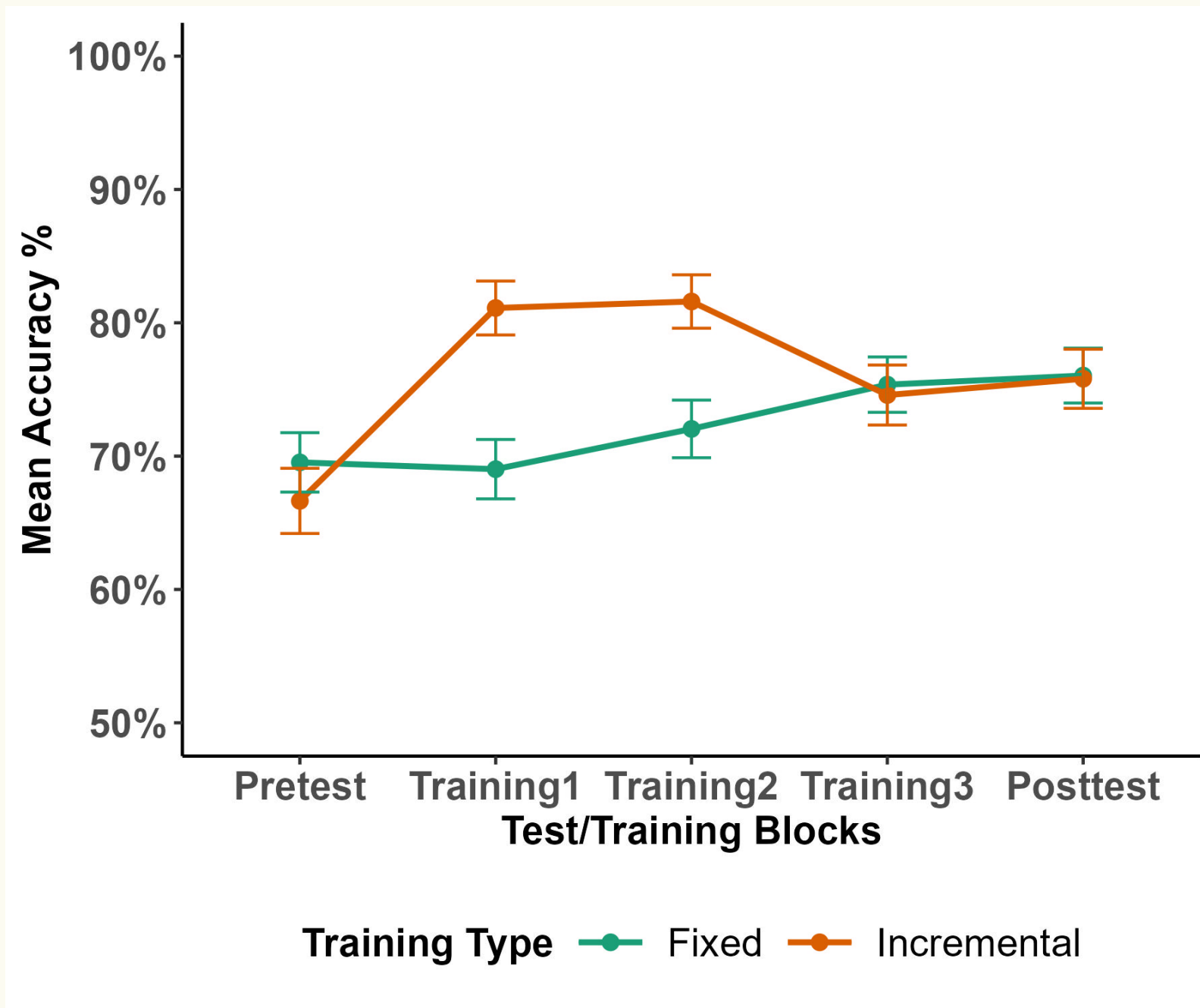
Statistical learning

- Direct manipulation of one dimension in isolation does not straightforwardly translate into phonetic reorganisation.
- This is regardless of stimuli complexity and training length.
- Category learning of speech requires input signals to be ‘informative’ and ‘categorisable’.

References

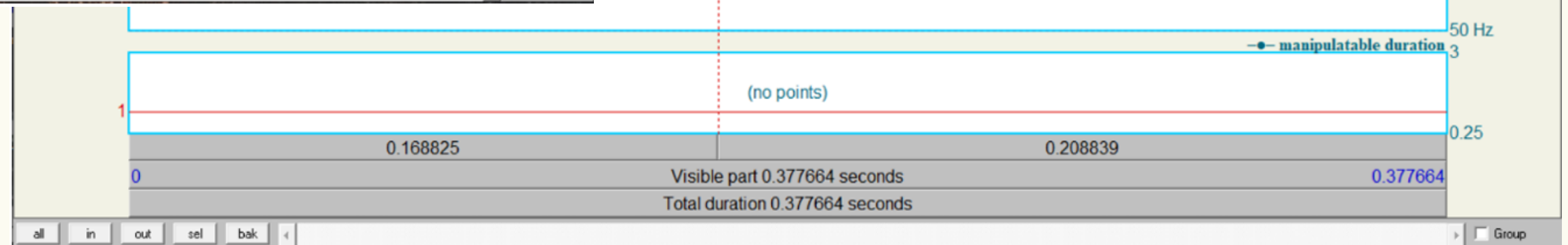
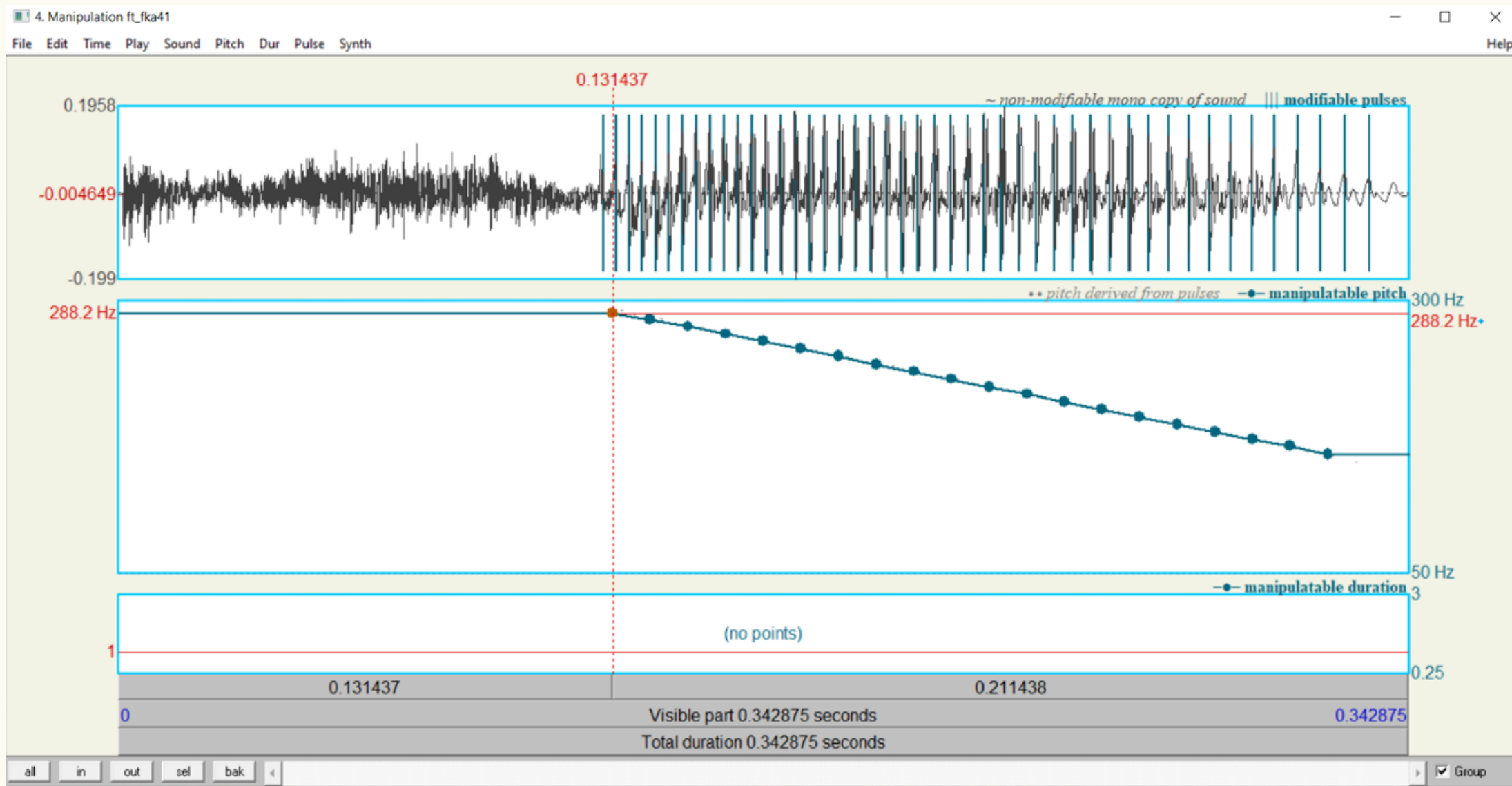
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Study 1 Results: Accuracy

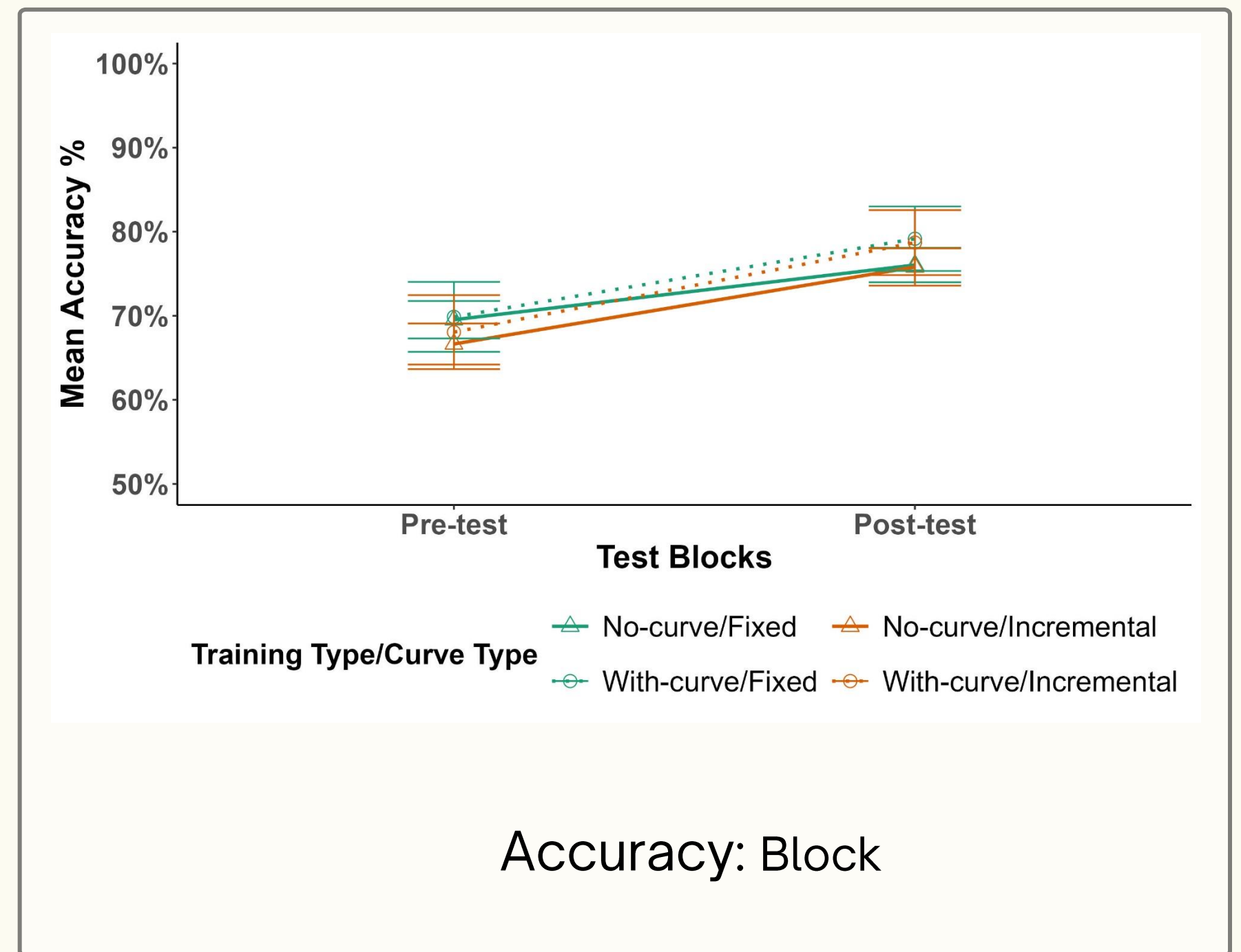
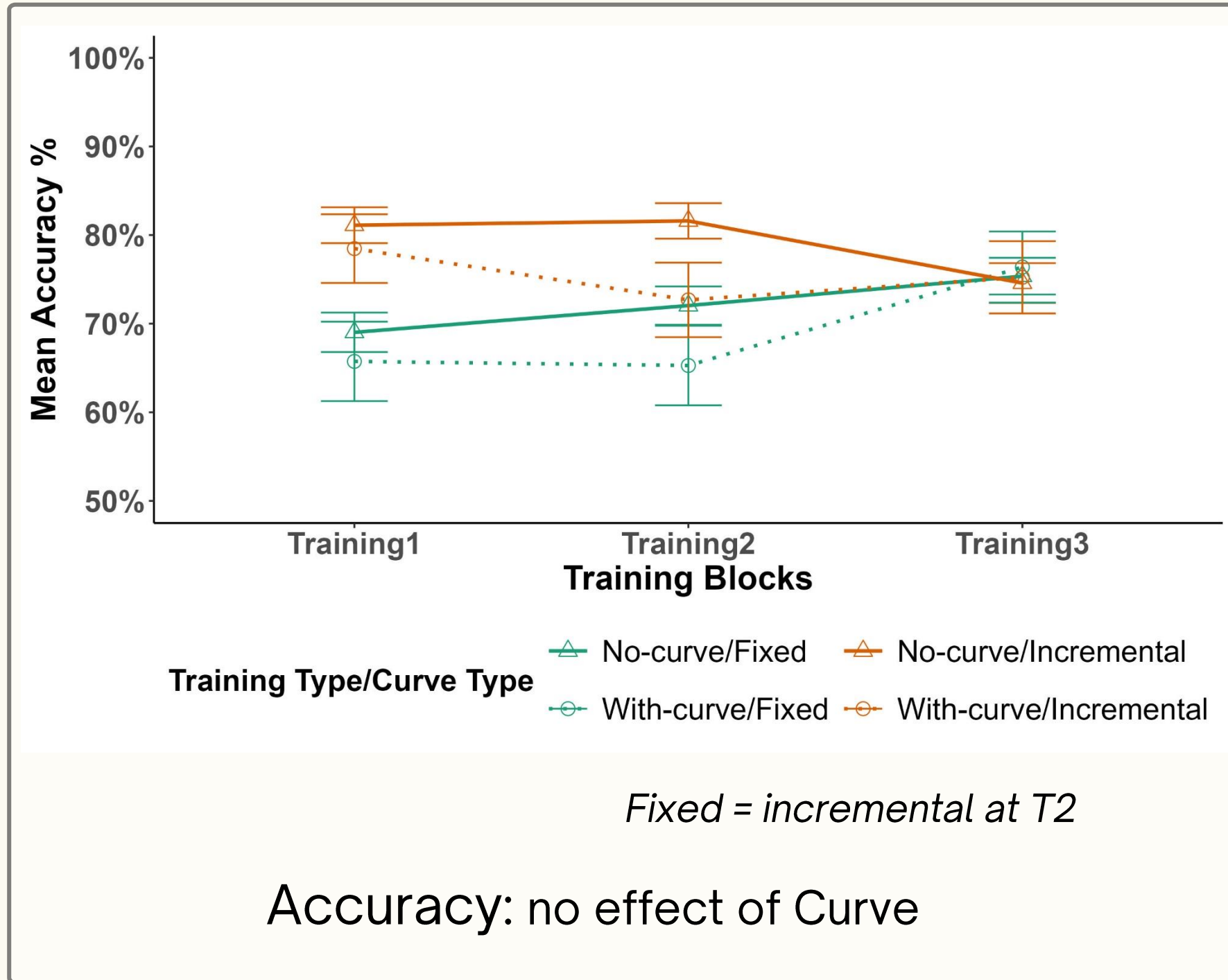


Overall accuracy
Pre-test = Training 1
Training 3 = Post-test

Study 1b (quadratic curves)



Study 1b (quadratic curves)



Study 4 BIS & Sensitivity scores: Tracking-test

